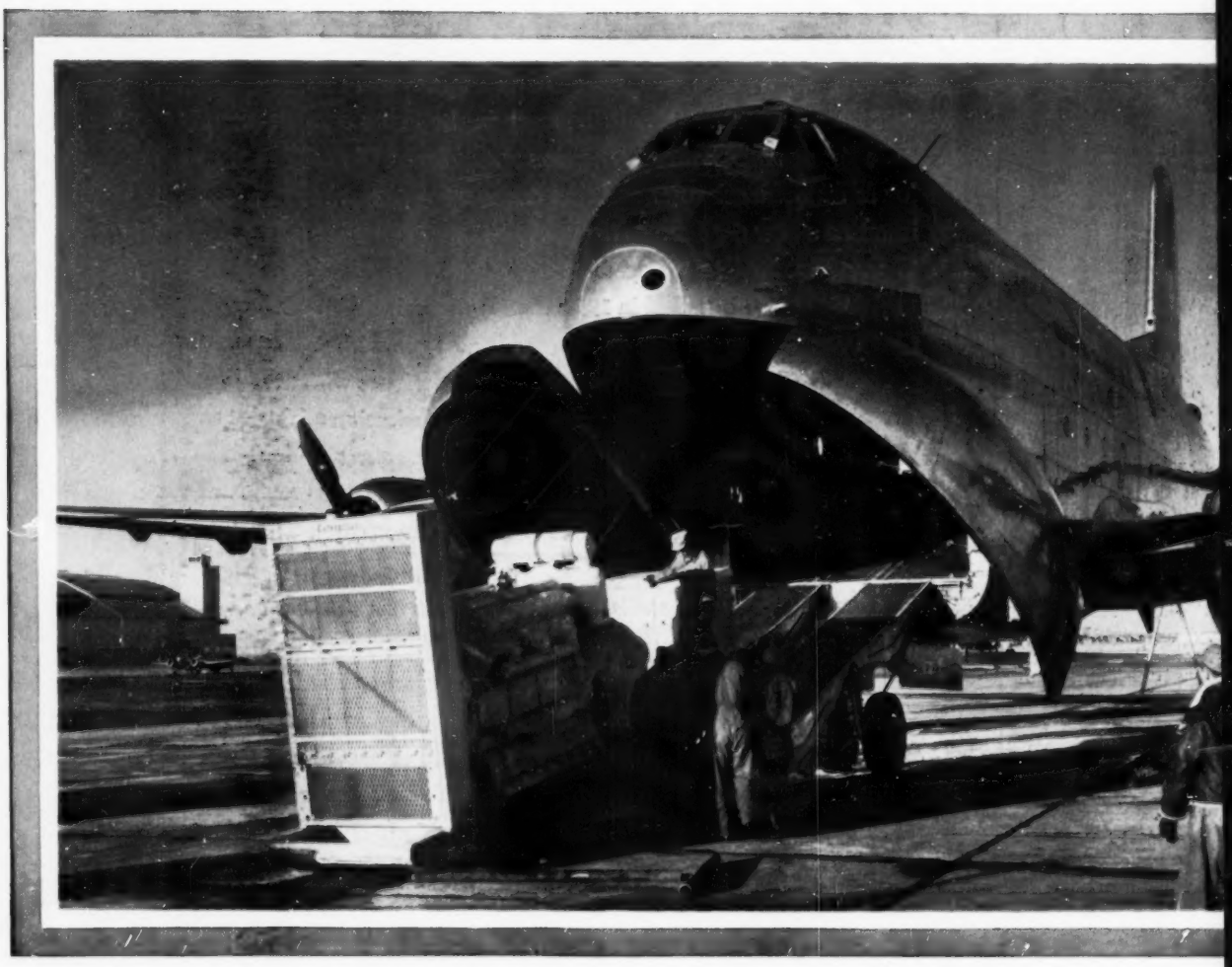
DIESEL POWER

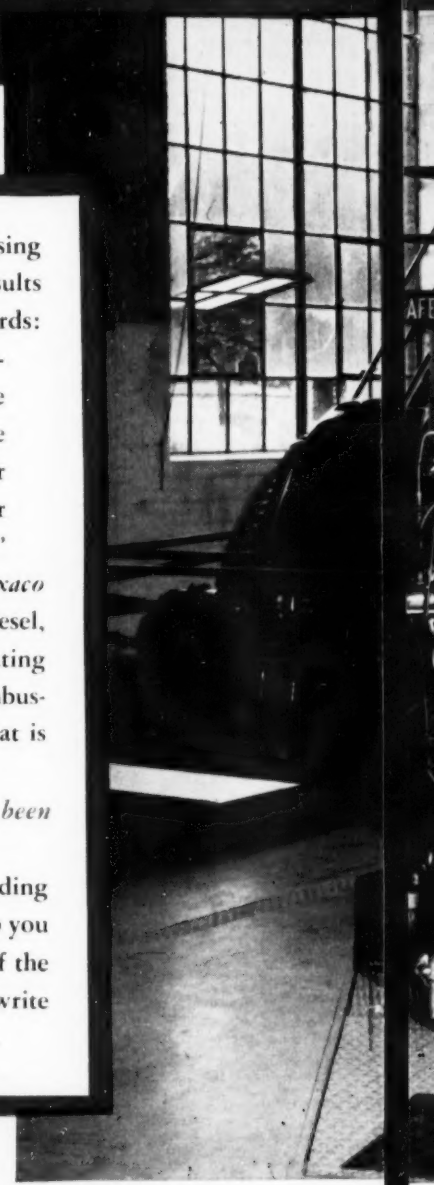
AND DIESEL TRANSPORTATION

MAY, 1953



- ***The Spectrograph As A Maintenance Tool***
- ***F-M's Small OP Engine***

"...SO MUCH BETTER LUBRICATION WITH



The Marshall (Michigan) Water and Electric Company started using *Texaco Ursa Oil* in two 5-cylinder Diesel engines in 1947. Results were so satisfactory – but read the story in the user's own words:

"We got so much better lubrication with *Texaco Ursa Oil* – lower maintenance costs and fuel economy – that when we installed a new 6-cylinder Diesel in 1948, we naturally chose *Texaco Ursa Oil* to lubricate it. Same with the 11-cylinder radial Diesel we installed in 1951. As new Diesels go into our plant, you can be sure *Texaco Ursa Oil* is going in with them."

The Marshall Water and Electric Company's experience with *Texaco Ursa Oil* is typical. *Texaco Ursa Oil* is made for lubrication of Diesel, gas and dual-fuel engines. It stands up under toughest operating conditions . . . keeps rings free for proper compression and combustion, lower fuel consumption and lower maintenance costs. That is why –

For over 15 years, more stationary Diesel h.p. in the U.S. has been lubricated with Texaco than with any other brand.

There is a complete line of *Texaco Ursa Oils*, approved by leading engine builders. A Texaco Lubrication Engineer will gladly help you select the proper one for your operation. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

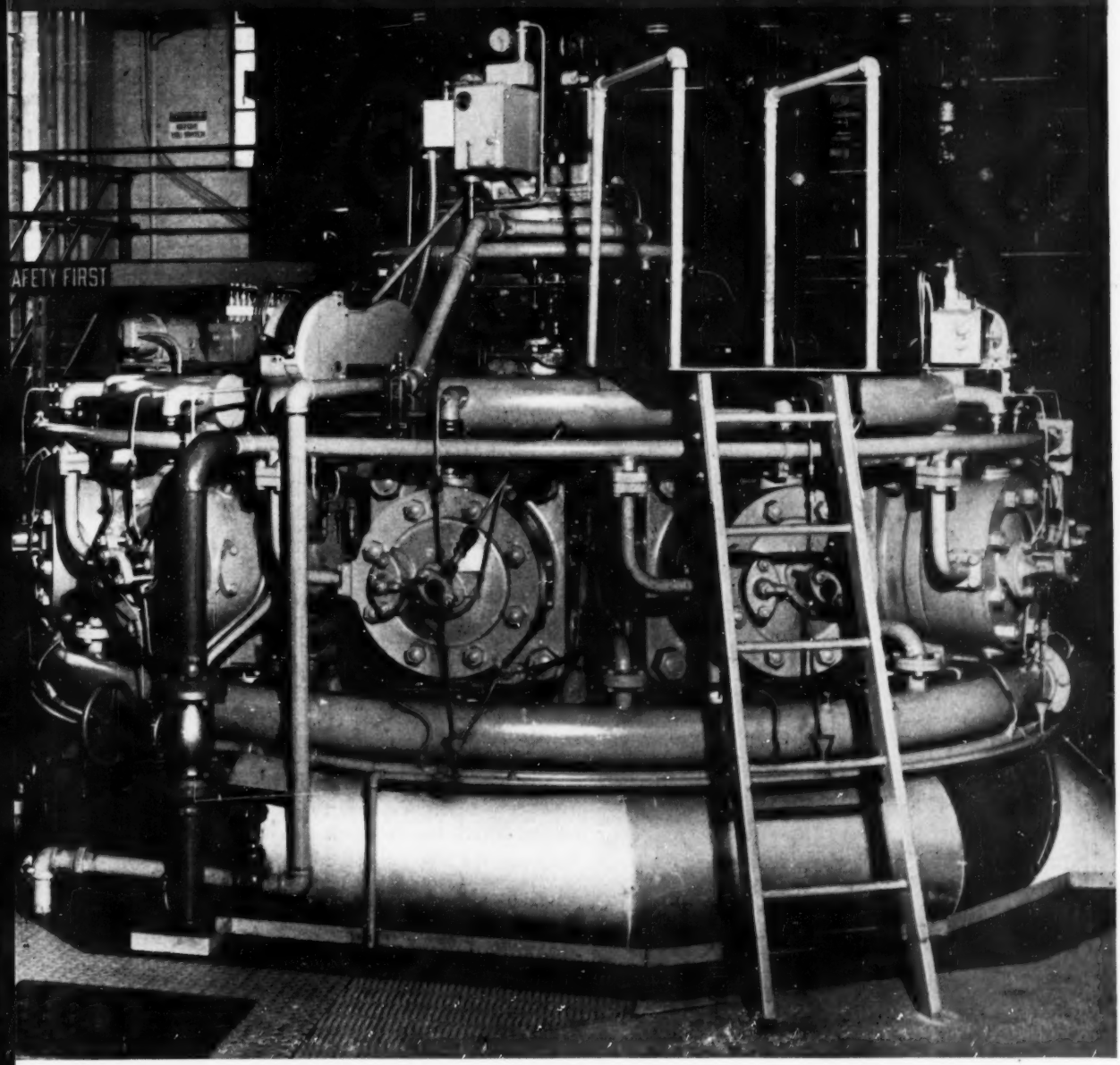
TUNE IN:
Tuesday nights
on television –
the TEXACO STAR THEATER
starring MILTON BERLE.

See newspaper for
time and station.

TEXACO

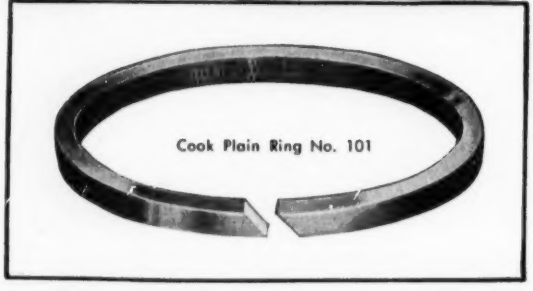
TEXACO

TEXACO URSA OIL"



URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

Three Reasons Why Cook Graphitic Iron Rings Cost Less in the long run!



First—

Cook Rings are "job-engineered". From data based on extensive field research and electronic indication of many makes of engines under all operating conditions, Cook engineers can recommend the rings that are best suited to your own specific engine and operating conditions.

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Cook Graphitic Iron is a proven ring material of known wear-resisting characteristics. It quickly develops a smooth anti-friction surface that keeps cylinder wear to a minimum and prolongs cylinder life.

Third—

Cook Graphitic Iron Rings are made to high precision standards. Their design and construction features assure a long lasting, efficient seal of cylinder pressures.

★ ★ ★ ★

Yes, it's this combination of correct application, a proven ring material and quality construction that pays off in better diesel performance. They're basic reasons why I always say that Cook Graphitic Iron Rings are the only rings I can afford to buy.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK
PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

DIESEL POWER
AND DIESEL TRANSPORTATION

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C. W. Kinnear, *Special Railroad Representative*
John H. Wetherell Jr., *Associate Editor*
Sylvia Zegar, *Editorial Assistant*

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May, 1953

Vol. 31, No. 5

Cover Photo: Being loaded into the open jaws of the huge Military Air Transport Service C124 Globemaster is a Cat D397 diesel-electric set for transportation to an air base in Greenland to meet an emergency power situation.

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Diesel Publications, Inc., 192 Lexington Avenue, New York 16, N. Y.

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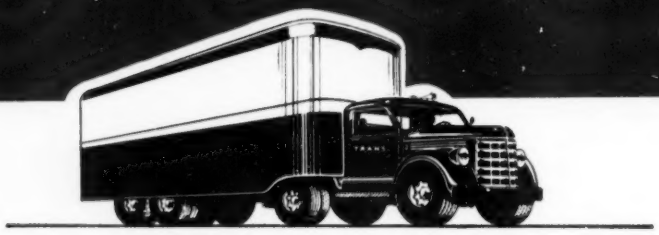
"Very good results" from Clevite* 77



HERE is additional proof of the reliability and low service cost of Monmouth* Engine Bearings.

A major Midwest freight line operating heavy vehicles over long hauls is noted for its on-time schedules. Clevite 77's are used in connecting rod and main bearings in its vehicles. They say results are "very good", averaging 185,000 miles per set of bearings. Delays due to bearing failure have been reduced about 75% since using Clevite 77 Bearings.

These bearings are made by the world's largest producer of original equipment bearings. You can depend on their original equipment design, quality and precision for passenger cars, trucks and buses. Distributed nationwide by NAPA Jobbers.

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Assurance of Quality

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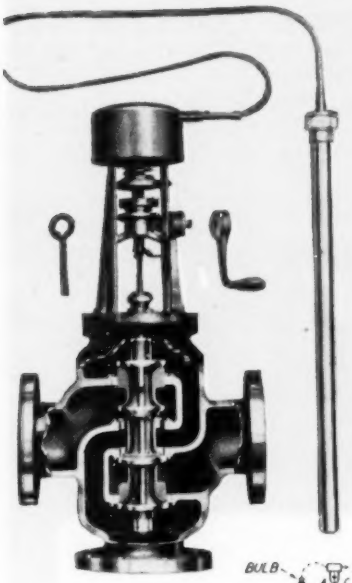
Monmouth

ENGINE BEARINGS
CLUTCH PLATES AND PARTS
CHASSIS PARTS

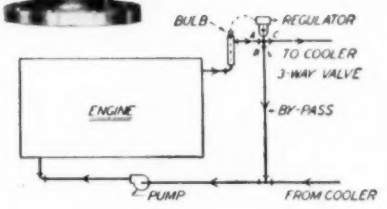
Made by The Cleveland Graphite Bronze Co. — supplied through Clevite Service, Inc.
Units of Clevite Corporation, Cleveland, Ohio.

AUTOMATIC TROUBLE-STOPPERS FOR ENGINES!

Sylphon Controls protect against bearing, piston, cylinder and other damage

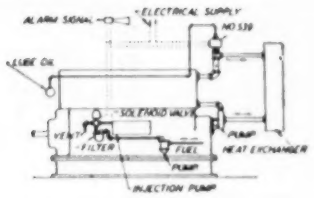


No. 923-3WB



CONTROLS TEMPERATURE. *Equipped with a 3-way valve which is automatically positioned to direct all or part of the water through a by-pass. No. 923-3WB maintains constant volume of water through pump and engine . . . gives quick warm-up . . . improves performance.*

No. 539



SOUNDS ALARM. *If water jacket temperature goes above, or lube oil pressure goes below the safe point, No. 539 sounds an alarm, flashes a warning signal or, if desired, shuts down engine operation. Fail-safe type. Rugged, reliable, compact—built for long, faithful service.*

● With Sylphon Controls, you can be sure that jacket water temperature and lube oil pressure will be safeguarded at all times. They protect engines against over-heating or low pressure troubles . . . improve lubrication . . . reduce fuel and oil consumption . . . minimize corrosion. Pay for themselves many times over in warding off costly shut-downs, damage or repairs.

The two Sylphon Controls pictured are typical of the line—a line made by specialists in this field for years. Send for information about them, or about other Sylphon Regulators to meet your specific temperature or pressure control requirements. Ask for Bulletin JD-817.

FIRST WITH BELLOWS

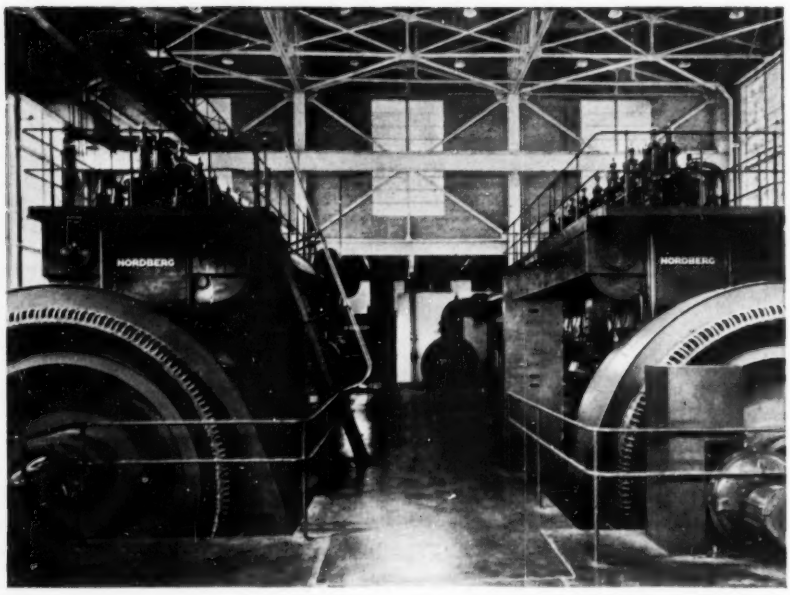
Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON
DIVISION

ROBERTSHAW-FULTON CONTROLS CO. KNOXVILLE 4, TENN.

Canadian Representatives, Darling Brothers, Montreal

W. T. Elliott,
Power Plant Supt.,
says...



"We've Got Facts to Prove Rubilene's Superiority"

A lot of people depend on Mr. W. T. Elliott. For it's his job as Power Plant Supt. to see that the City of Denton, Texas has unfailing light and power 24 hours a day. To help live up to that responsibility, Mr. Elliott pampers his hard working Nordberg Duafuel® engines — makes sure they're lubricated with the finest oil available. He says, "We've been using Sinclair RUBILENE® since 1948 with *very satisfactory results*. Cylinder liner wear is only ⅓ of 0.001 inch per 1,000 hours running. Piston ring life is 16,000 hours of operation and we get 6,100 H.P. hours per gallon of oil... Facts like those have definitely sold me on RUBILENE."

Why not let the facts prove to you, too, RUBILENE is a superior lubricating oil. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

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XF HEAVY-DUTY BATTERIES

For dependable diesel starting—lower operating costs

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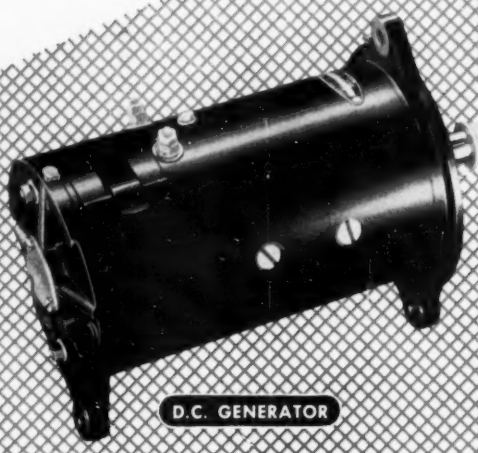
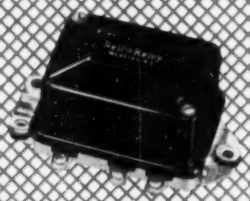
1888
DEPENDABLE BATTERIES FOR 65 YEARS
1953

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 2 • Exide Batteries of Canada, Limited, Toronto

Right for the Job!





DELCO-REMY HEAVY-DUTY 5⅝" DIAMETER GENERATORS AND MATCHING REGULATORS

Delco-Remy heavy-duty 5⅝" diameter generators have made a name for themselves with Diesel users who need units that develop full output at low speeds on governed Diesel engines. These Delco-Remy generators have exceptionally long brush life (100,000 miles or more is common) and, because of their durable construction and simple, dependable lubrication system, require a minimum of maintenance.

Heavy-duty features include an extra-heavy, rigid armature shaft, extra-large brushes and commutator, ball bearings in both commutator and drive end frames, wick-type lubrication with oilers, and forced ventilation.

These generators, with a frame diameter of 5⅝ inches, are available in 6-, 12-, 24- and 32-volt models. Six-volt models have capacities as high as 55 amperes, 12-volt models as high as 50 amperes. The 24- and 32-volt models provide outputs of 20 and 15 amperes, respectively. Matching regulators are available for all models. Specify Delco-Remy heavy-duty generators with mounting brackets and pulleys when ordering new vehicles.

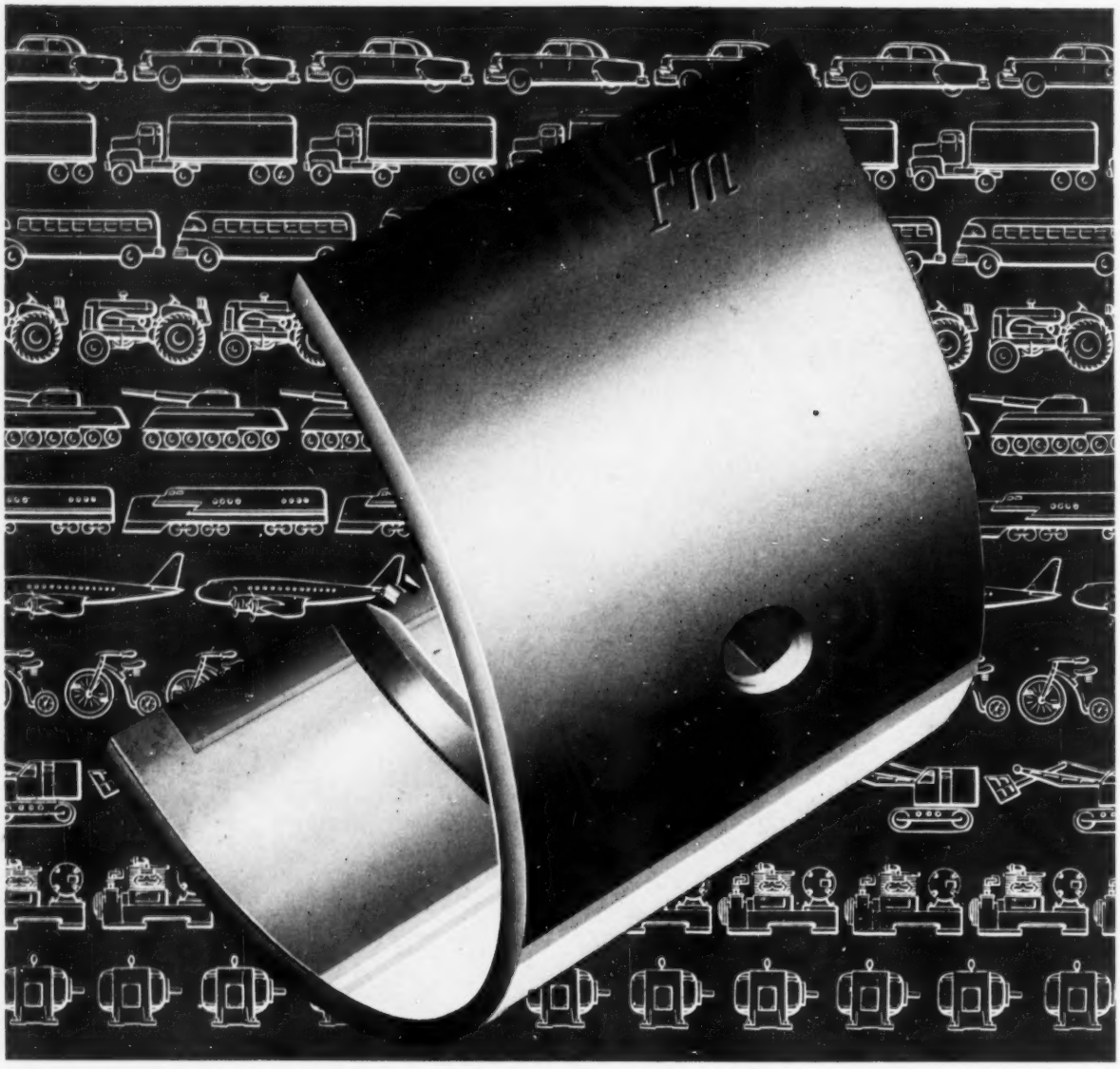
DELCO-REMY
Division, General Motors Corporation
Anderson, Indiana

WHEREVER WHEELS TURN OR PROPELLERS SPIN

greatest name in diesel fuel injection...

AMERICAN BOSCH

Look to American Bosch
for continued leadership
in diesel fuel injection.



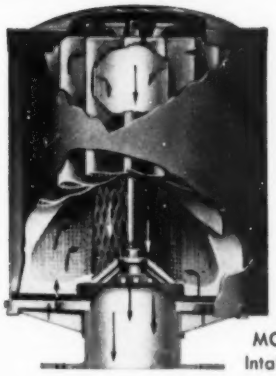
A Dependable Service for Over 50 Years

Sleeve bearings in a wide variety of designs and sizes; cast bronze bushings; rolled split-type bushings; bimetal rolled bushings; washers; spacer tubes; precision bronze parts and bronze bars.

FEDERAL-MOGUL CORPORATION 11041 Shoemaker · Detroit 13, Michigan

FEDERAL-MOGUL

BEST ENGINE PROTECTION MONEY CAN BUY!



MODEL D
Intake Filter

STAYNEW INTAKE FILTERS

STAYNEW INTAKE FILTERS keep shutdowns and repairs at an absolute minimum. Industrial engineers everywhere know that Staynew's *positive protection* lengthens engine life. They may cost more than ordinary intake filters, but with Staynew, you're assured of engines operating at top performance years longer. Staynew Intake Filters' extreme efficiency protects vital engine parts without carefully held maintenance schedules. And, efficiency actually increases with use. They're efficient over a wide range of loads, not affected by temperature changes, there's no oil carry over and no oil blow-out on free air unloading compressors. To keep equipment young *longer*, always specify Staynew.

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ALL TYPES OF FILTERS
FOR EVERY INDUSTRIAL NEED

Fewer Shifts for Faster Trips

Take a ride in any mechanical-drive off-highway truck. Watch the driver work all the way as he double-clutches, slows down, shifts and speeds up over and over again. He'll be using up to ten transmission speeds to make his run and it'll be tough going all the way.

Now take that same trip in a truck that has an Allison TORQMATIC DRIVE. The driver's left foot will be idle because there's no clutch pedal to push. Notice how he just flicks a lever to shift *without slowing down.* And notice that with the flexibility of the torque converter he needs only three forward speeds to adequately handle all loads and grades. He'll be making fewer shifts and be back for another load a lot faster. Faster trips mean more pay loads per day.

Matched units built by one manufacturer, Allison TORQMATIC DRIVES cut operating and maintenance costs by absorbing harmful shock loads. Ask your equipment manufacturer, dealer or write:

ALLISON *Division of* GENERAL MOTORS
Box 894SS, Indianapolis 6, Indiana

ALLISON TORQMATIC DRIVES

Unbeatable Team for Maximum Operating Economy

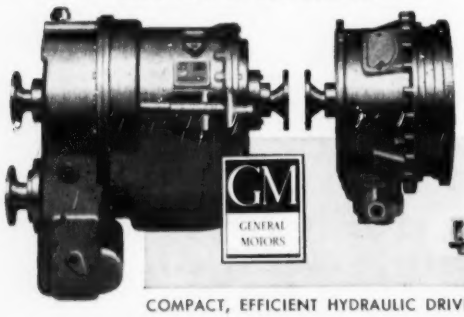
**Quick-shifts* at full throttle with fingertip hydraulic control.

**Holds* power to load at all times — no clutch pedal to push — no gearshift guess.

**Cuts* maintenance cost by absorbing shock — eliminates engine lugging — prolongs equipment life.

**Only* torque converter — transmission team designed to work together as a unit and built by one manufacturer.

MATCHED UNITS BUILT BY ONE MANUFACTURER

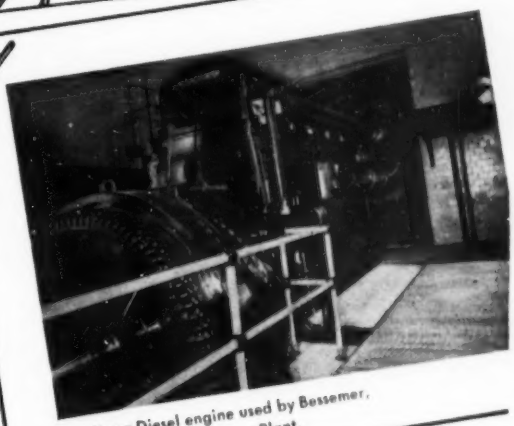


Allison TORQMATIC DRIVES

COMPACT, EFFICIENT HYDRAULIC DRIVES FOR CRANES * TRUCKS * TRACTORS * SHOVELS * SCRAPERS * DRILLING RIGS

*Could you make this report about your diesel engine?**

CITY OF BESSEMER, MICHIGAN REPORTS:



Nordberg Diesel engine used by Bessemer, Michigan Municipal Power Plant.

PISTONS PULLED AT 24,600 HOURS!

- All rings were free
- No carbon in ring grooves
- All original rings replaced in original grooves
- Rings should last at least 10,000 more hours
- Maximum cylinder wear was .004 at top, .002 at bottom

OIL CHANGE AT 5000 HOURS!

- No oil added to crankcase between changes
- Power cylinders fed at rate of 5 drops per minute
- Main bearing, rod bearings show very little wear
- Average K.W. per gallon of fuel is 13.5 @ 60% load factor

EXCELLENT

Sam Kalember

Superintendent,
Bessemer Light Utility.

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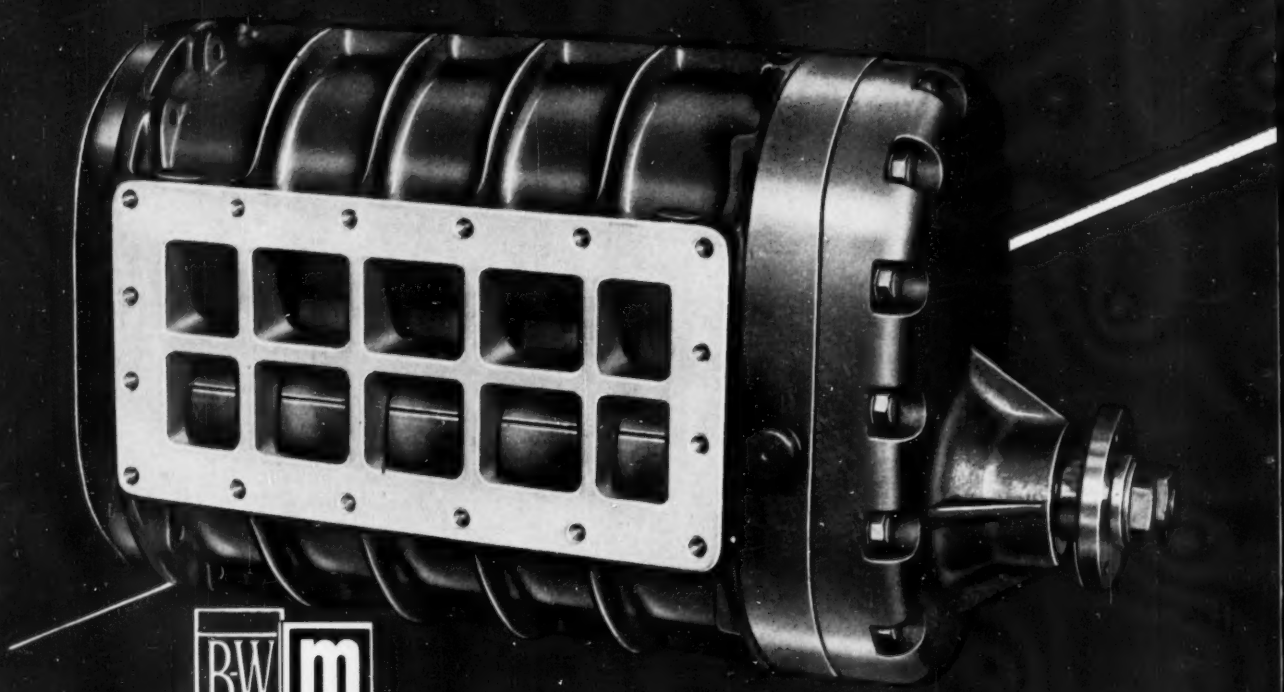
Cities Service DC-930 Oil used for crankcase lubrication!

Cities Service DC-230 Oil used for power cylinder lubrication!

* Why not contact your nearest Cities Service Representative or write Cities Service Oil Company, Dept. E7, Sixty Wall Tower, New York City 5, New York.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS



B-W m-d

A NEW NAME FOR A famous Supercharger

MIEHLE-DEXTER supercharger boosts power, decreases weight-to-horsepower ratio on leading Diesels.

Extra Power to Pull Heavy Loads! Power that means less engine space, less weight per horsepower and more *usable* horsepower. That's supercharging with performance-proved M-D supercharger.

Lab tested for efficiency at Borg-Warner's supercharger laboratory, it's the same supercharger proved for staying power, efficiency and low maintenance service on leading Diesels.

Exclusive Features Improve Performance. The M-D supercharger's exclusive end plate design and tip insert reduce rotor end clearance and improve engine fuel economy. Lightweight 3-lobe rotor cuts vibration and allows high speed safely . . . to improve efficiency.

Specify standard M-D models for your applications from 100 to 750 h.p. Or for special requirements consult your M-D engineer.

For more facts write Miehle-Dexter Supercharger Division, Racine, Wisconsin.

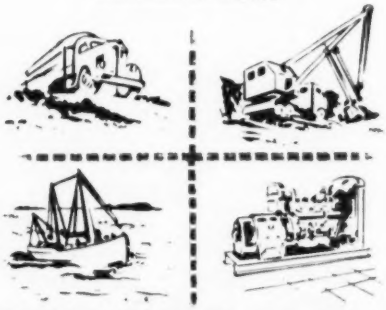
FIELD TESTED ON LEADING DIESELS

The M-D supercharger has won universal acceptance on engines produced by many of the leading Diesel Engine manufacturers, including the following:

Buda Cummins Murphy

Venn-Severin Hercules

Fairbanks-Morse

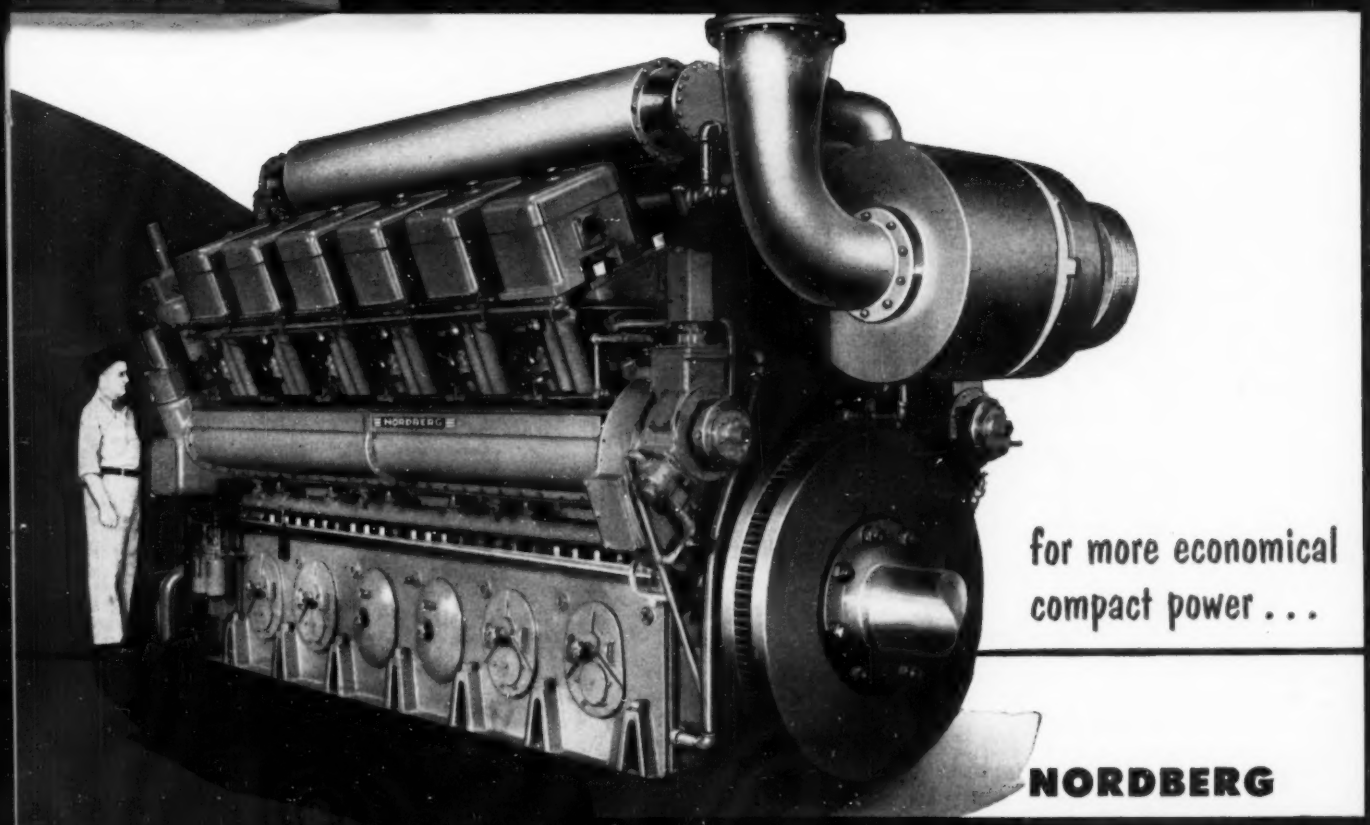


The M-D positive displacement supercharger is now engineered and produced by the Miehle-Dexter Supercharger Division of the Dexter Folder Company. The Division maintains complete servicing and repairs for new superchargers and for the thousands now in operation.

m-d

MIEHLE-DEXTER SUPERCHARGER DIVISION

100 FOURTH STREET • RACINE, WISCONSIN



for more economical compact power . . .

NORDBERG

- COMPACT
- HIGH THERMAL EFFICIENCY
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- WIDE HORSEPOWER AND SPEED RANGE

SUPAIRTHERMAL

FOUR-CYCLE V-TYPE ENGINES

. . . another important Nordberg advancement in the design and development of more efficient engines

Here is the Nordberg four-cycle SUPAIRTHERMAL V-Type engine . . . designed and built for continuous low cost operation for a wide range of stationary and marine power applications. This engine is available in 12 or 16 cylinders of 13″ bore in Diesel, Duafuel or Spark-Fired Gas types from 2400 to 4260 hp at 450 to 600 rpm.

The design of this V-Type engine incorporates all tested and proved performance features of Nordberg 13″ bore in-line SUPAIRTHERMAL engines. The high thermal efficiency of the SUPAIRTHERMAL engine is made possible by variable inlet valve timing control . . *an exclusive patented Nordberg feature.*

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Builders of America's largest line of heavy-duty Diesel engines from 10 to over 10,000 horsepower

NORDBERG

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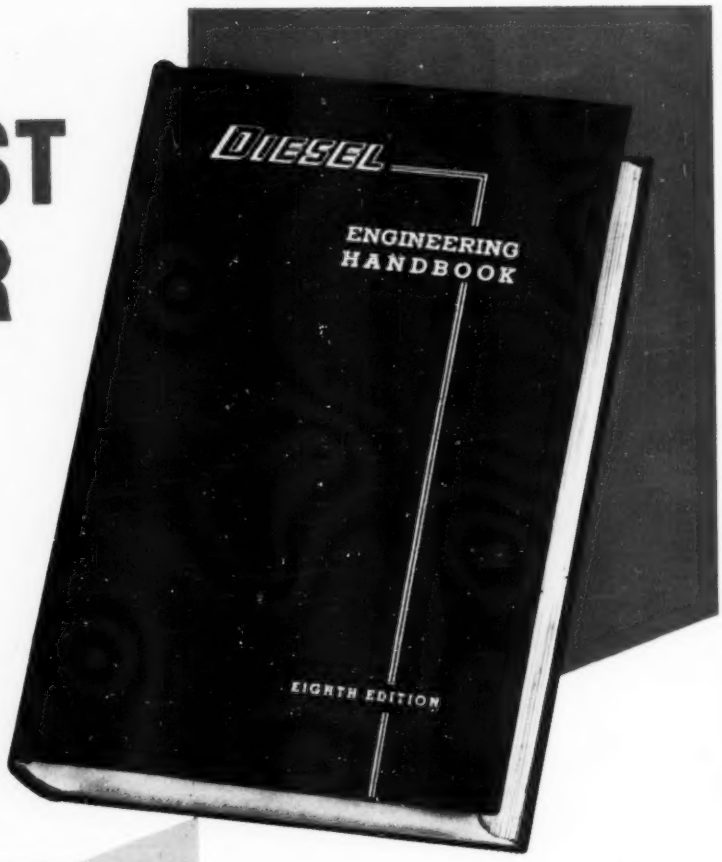
THE MOST POPULAR DIESEL BOOK

Completely Revised Bigger and Better Than Ever Before

at the same old Price **$7.50**



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For 18 Years The DIESEL ENGINEERING HANDBOOK has maintained its leadership and popularity as the "Most Useful Diesel Volume".

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More Chapters
More Subjects
More Information
More Pages
More Illustrations

New Marine Section
New Engine Descriptions
New Diesel Specifications
New Fuel Injections Systems
New Governor Systems

FOR ALL DIESEL MEN

Never before in the 18 year history of this book has such a complete revision been made.

Although 40,000 copies of previous editions have been sold to satisfied readers, we are never content to rest on our laurels. All Diesel Men use the DIESEL ENGINEERING HANDBOOK from designer to student—Owner to plant engineer —Consulting Engineer to Engine Erector.

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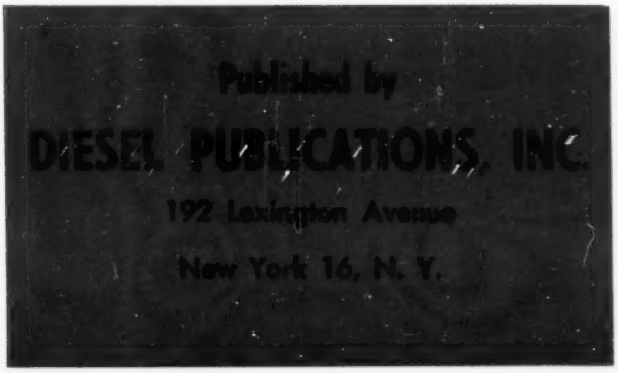

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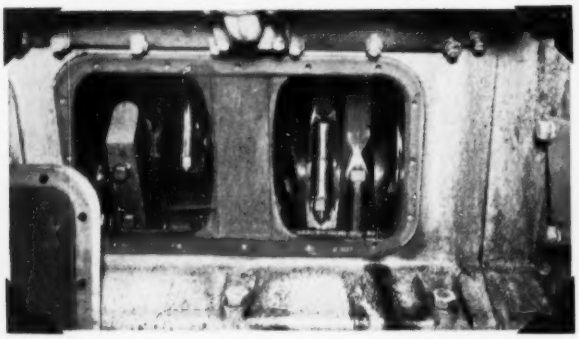
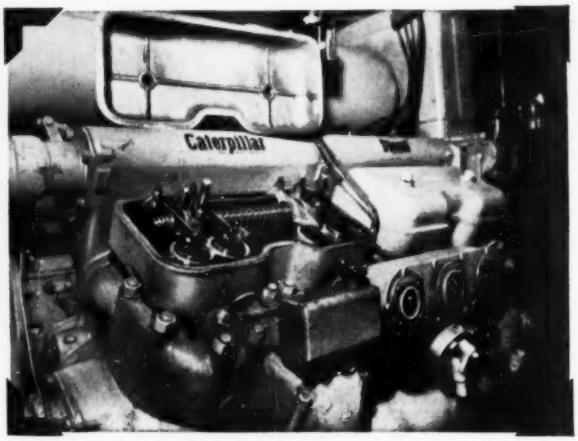
THE ENGINEER'S REPORT

DATA

LUBRICANT	RPM Delo Oils
UNIT	Caterpillar D-375 diesel
SERVICE	Coastal fishing—bottom fish
CONDITIONS	Constant load
FIRM	A. Paladini, Inc. Fields Landing, Calif.

Heavy-duty engine clean after 4146 hours' work!





AFTER 4146 HOURS of steady work in the 270 H.P. supercharged diesel propulsion engine of the Catherine Paladini below, note how clean and free from deposits RPM DELO Supercharged—2 Lubricating Oil has kept parts. Crankcase drains and filter changes at 1500-hour intervals have shown no sludge, according to Axel Bjork, Skipper. He says, "The engine ran perfectly during the more than 4000 hours of tough work—if anything, it runs better now than at first."

THE 73-FOOT-LONG CATHERINE PALADINI has a 19.6 beam. She fishes from Oregon to San Francisco, bucks heavy seas and tides on trips that last from three days to over a week. Seas were exceptionally heavy during the past winter, giving her new engine an extra tough workout.

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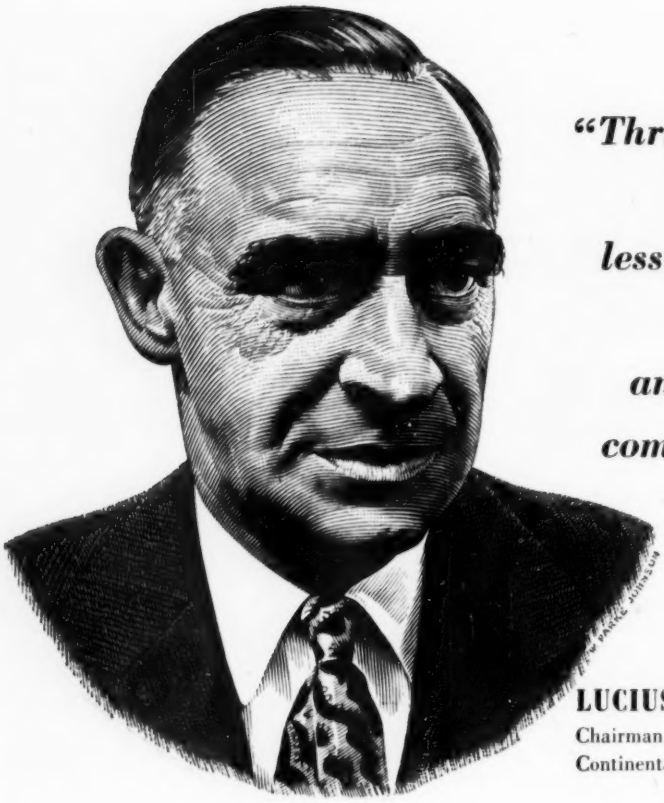

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LUCIUS D. CLAY
Chairman of the Board
Continental Can Company

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DIESEL POWER & DIESEL TRANSPORTATION

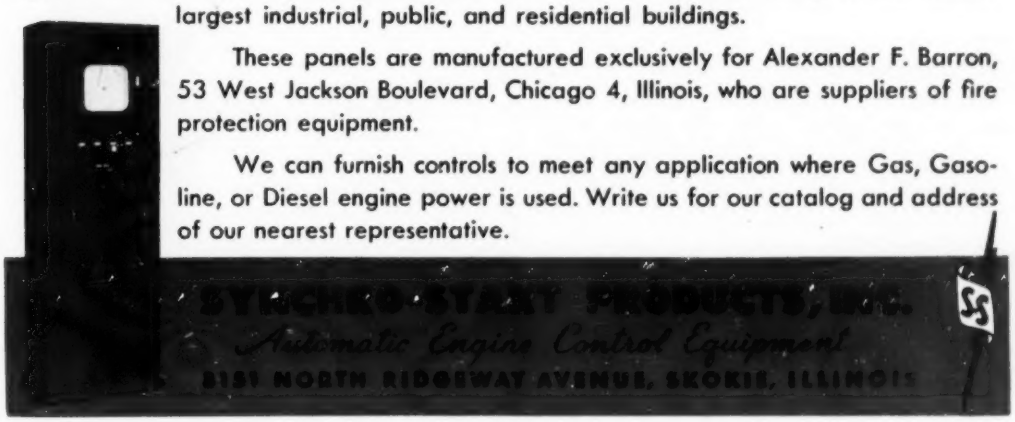
STANDBY ENGINE POWER

Many of the Air Lines have installed automatic engine driven pumps in their hangars at the principal air terminals to insure against failure of water supply in case of fire.

Also, most main air terminals have automatic standby generator sets which will supply current for the lights and control tower within a few seconds, should the commercial source of power fail.

SYNCHRO-START has been making the controls for these power plants for the past twenty (20) years and have the "know how" to build controls that remain dependable. They are in use for every conceivable power application on land, sea, air, and in the mines.

The Universal Automatic Engine Control panel shown, is for fire protection to automatically START-STOP, and give the ALARM when needed and to record the operations including automatic test runs. They are accepted as wholly dependable protection against fire by insurance companies and are in use in a great many of the nations largest industrial, public, and residential buildings.



These panels are manufactured exclusively for Alexander F. Barron, 53 West Jackson Boulevard, Chicago 4, Illinois, who are suppliers of fire protection equipment.

We can furnish controls to meet any application where Gas, Gasoline, or Diesel engine power is used. Write us for our catalog and address of our nearest representative.

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*Aftercooling water-cools combustion air between supercharger and intake manifold, thereby permitting more air for greater power and higher efficiency.

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Chrome-Faced Cyclan Ring

More about Cyclan

Sealed Power's amazing new piston ring material

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Cyclan is a high-strength, heat-treated alloy iron with strength approaching that of steel, and with resilience and life-expectancy far exceeding cast iron. Cyclan has the ability to retain its physical properties under extreme operating heat. Its bearing characteristics resemble those of cast iron. Cyclan was developed by Sealed Power.

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Cyclan stands up where engines are subjected to extreme operating conditions, pulling heavy loads over rugged terrain. Cyclan piston rings will not break in supercharged engines. Their gaps will not change under extreme heat. Cyclan metal is not affected by temperatures 50% higher than those at which standard piston rings irons fail. Cyclan possesses extraordinarily high impact value for shock, resistance and can undergo considerable distortion without sacrificing resilience.

Cyclan is available for original equipment piston rings in heavy duty engines. Some Sealed Power Cyclan Piston Ring sets are available for replacement now. Others will follow soon.

Let our engineers tell you the Cyclan story!

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CYLINDER SLEEVES

Editorially Speaking . . . .

Concerning Instruction Manuals . . . .

Anyone in the technical writing business knows the labor and travail that goes into the preparation of an instruction manual. Perhaps, to others it is not so apparent.

The text is carefully written, checked, rewritten, re-checked, and finally polished. Illustrations are carefully selected to show just the points that are meant to be emphasized, the pictures are retouched, carefully sized, engraved and captioned. Text and pictures are printed and bound.

Finally, our instruction manual is brought forth after great pains and labor. It is ready to go out into the world in all its pristine beauty. Then what happens; it falls into the hands of *people.*

Some sage once remarked, "It takes all kinds of people to make a world." Let's see what might befall our unsullied manual.

It might fall into the clutches of a man with a "work of art" or "treasure" complex. This manual is too nice a thing to be left around where it might get into someone's dirty hands and get smudged up. So he carefully puts it away out of sight—and too frequently out of mind.

The years pass; the engine is worn out or sold; and someone finds our manual on a top shelf somewhere or behind a lot of things in an old cabinet. "What's this junk?" he remarks as he beats the dust from it and finally tosses it in the rubbish. So our manual leaves this world after a completely useless life.

A variation of this is the man with the "inferiority" or perhaps a "I've-got-to-be-smartest" complex. He snags on to the manual and hides it away in his desk. Then if someone in the shop wants some answers they have to come to him. He can then peek, pass along the info — sometimes garbled — and play the part of the "big brain."

This fellow is usually afraid that someone in the shop may learn something for himself and shoot for his job. Who's he kidding?

Or perhaps our manual will fall into the grimy paws of the "know-it-all" psychotic. To him all manufacturers are dumb; don't know a thing. He is the type that promoted this comment heard at an AERA meeting: "All instruction manuals should have gasket material covers; then some of these fellows would at least get some use out of them."

If our manual falls into these hands, it's a dead duck; no chance to be useful here. It will wind up "unread, unhonored, and someone is stung."

Yet there is a bright side. Do you know that there are people who yearn for these manuals just as orphans yearn for a likely prospect on visiting day? We have a letter from a man in Australia on our desk beseeching us to get him some — not for himself alone, but so that he can use his meager store of texts to help a great many others that come to him for information.

Then there is the man that digests the information in the manual when he gets it with the engine. He applies the information intelligently to fit his own application and keeps the manual handy for reference when there is a job to be done.

This manual bears the scars of a useful, active life. But then, who doesn't? — that's the way it is supposed to be. These manuals are to be used. They represent a lot of time and money spent by the manufacturer to help you get your money's worth out of his product. If this is accomplished, he has no better advertisement and our manual serves its purpose.

When an engineer needs some help on a formula, he is liable to go to a well-thumbed Kent or Marks Handbook. When your wife makes that extra-special dish, she gets out the recipe. Well, your best recipe when you have to do a job on your engine is the instruction manual.

Where do you fit in this picture?—think it over.

...with TYCOL lubricants on hand!

Top this record! A well known utility company has operated a turbine for *almost 12 years* without an oil change or cleaning. At a rate of less than 10% "make-up" per year, Tycol Aturbrio has served the plant without malfunction – for years on end. And Tycol Aturbrio performance records show turbine after turbine running well over 100,000 hours without a change! That's *proven stability* . . . further substantiated by the regular use of Aturbrio as an outstanding hydraulic oil. Full data on Aturbrio performance is available from your local Tide Water Associated office.

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+ HIGHLIGHTS +

● The Ford Tractor Company, Ltd., of England, recently announced that 95 per cent of all future tractor production would be diesel-powered.

● From June 28 to July 2, the Petroleum Equipment Suppliers Association will hold its annual meeting at the Broadmoor Hotel in Colorado Springs, Colorado.

● A recent shipment from GM Diesel Ltd. of three diesel locomotives completed an order for nine for the Newfoundland division of CNR.

● Today, according to AAR's November 1952 figures, diesels turn out about 67 per cent of all freight service, more than 74 per cent of all passenger service, and more than 78 per cent of all yard and switching service.

● The safest place to work in the GE Co. is amid the power saws, drill presses, and corrosive chemicals of the GE laminated plastics plant at Coshocton, Ohio, where more than 700 employees have worked nearly 3½ million accident-free hours.

● Top officials of the Norwegian State Railways are currently visiting the United States in an effort to learn more about the operation and maintenance methods used on American railroads.

● The Atlantic Coast Line is presently studying facilities made obsolete by the change from steam to diesel in an effort to determine what use or disposition can be made of these facilities.

● During 1952, the United States produced 55.7 per cent of the oil in the free world.

● Cash prizes totaling $7500 have been offered to employees of the Santa Fe road in a new employee contest. The object is to stimulate employee thinking in connection with prevention of loss and damage to freight shipments.

● From a recent AAR release, we note that 2736 diesel-electric locomotive units were installed in service on Class I roads during the 12-mo period ending February 28, 1953.

● During the last week in May, the American Society of Mechanical Engineers, Oil and Gas Power Div., will hold their annual convention and exhibit at the Shroeder Hotel in Milwaukee, Wisconsin.

● A recent release from the API states, "Before the average car is scrapped, it will have consumed 8000 gal of gas and run up $588 in gasoline taxes."

● From Canada we hear that there has been an increase of 34 per cent in diesel fuel consumption during the last year. This figure represents highway transportation only.

● Atlantic City, New Jersey will be host to the Society of Automotive Engineers from June 7 to 12, when they hold their summer meeting.

● As a part of a construction program now underway, the El Paso Natural Gas Company is making the first large scale use of gas turbines for transmitting natural gas over long distances.

● According to a recent U. S. Department of Agriculture report, there are over 4,200,000 farm tractors now in use. Prior to the start of World War II, they numbered 1,700,000. The percentage of diesel power in this field is also increasing rapidly.

● More than 11 million bbl of diesel fuel are produced each month by American refineries, according to the third annual report of the U. S. Bureau of Mines. According to the latest count, there are approximately 34 different models of diesel-powered farm tractors currently being offered by American manufacturers. It looks like the farmers are realizing the advantages of diesel power.

● Edgewater Beach Hotel, Chicago, Illinois, is the place set for the annual meeting of the National Lubricating Grease Institute.

● As of January 1953, pipeline mileage totaled 168,301 miles. Of this amount, 27,300 miles of pipeline carry refined products to market places.

● The annual meeting of the American Society for Testing Materials will be held in Atlantic City, New Jersey, from June 29 to July 3.

● From GM, we hear that after having turned to diesel as the most efficient motive power for passenger and freight locomotives, the railroads are now dieselizing other equipment such as railroad-type cranes.

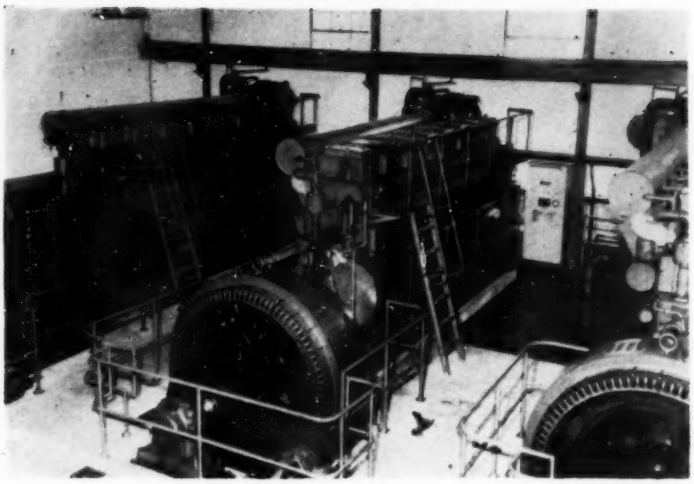
● On a recent trip through Canada, Japan's Crown Prince Akihito saw the Rocky Mountains through the windshield of a diesel-electric locomotive. This was the first time he had ever ridden in or seen a diesel locomotive.

● The sixth Canadian International Trade Fair will be held from June 1 to 12. Some 20 countries will be represented in the exhibits.

● GM recently dedicated its 2280-acre desert proving ground near Phoenix, Arizona. One of the main projects to be conducted here will be the observation of engine and oil cooling systems at sustained high speeds.

● The National Board of Fire Underwriters recently announced that Fire Prevention Week will be observed October 4-10. This doesn't mean you can be careless during the rest of the year.

● Recently, an official of a machinery firm located near Bluefield, West Virginia, came up with the idea of hitching a circus elephant and a tractor back-to-back to match pulling power of the two. The tractor lost to the muscles of the pachyderm. Ha! No diesel power.



Of the three 1760 hp 4-cycle supercharged Worthingtons carrying the bulk of the load, two operate on heavy fuel.

Tarboro Cuts Costs

By R. M. Weatherly*

Operating three diesel generating units on heavy fuel instead of the more expensive light oil has reduced Tarboro's per kwh fuel costs by approximately 34 per cent.

TARBORO, North Carolina has been one of the pioneers in heavy fuel operation. With a present total capacity of 2550 kw, the plant supplies the town of 8000 people and dozens of small industries in the community. Long a municipal operation, the plant was converted to diesel power in 1928 with the installation of two 8-cyl, 900-hp MacIntosh and Seymour air injection engines. In 1937 however, load conditions dictated the addition of a larger diesel.

At this time, a 5-cyl, 1250-hp Nordberg was installed. Plant load continued to grow and finally in 1949, a new wing was added to the plant. Along with this addition came three 16-in by 20-in supercharged 4-cycle Worthington engines, each developing 1760 hp at 360 rpm. During the planning stages of this new extension the high costs of light fuel led town officials and engineering consultants to select engines capable of burning a cheaper, heavier fuel.

Manager, Municipal Light and Power System, Tarboro, North Carolina.

Fuel, Water and Lube Systems

Planning also included designs for a fuel system to efficiently handle heavy fuel. A parallel fuel system was designed with capacity to serve just two engines. Therefore, under present operating procedure, two of the Worthington engines divide the major portion of the load operating on heavy fuel, with the third Worthington and the Nordberg handling most of the balance and operating on light oil. The No. 5 fuel now in use has an API gravity of 15.5, viscosity 250 SSU at 100°F, sulfur 1.59 and ash .04.

The parallel system was necessary because of the fact that the heavy fuels are not of sufficiently low viscosity to enable their use until after the engines have been started and thoroughly warmed up. In addition to supplying light fuel for starting and stopping purposes, the parallel system also insures reliable operation regardless of auxiliary equipment failure or unavailability of any given type of fuel oil.

With a flexible fuel system of this type the operator can use either fuel or any combination of the two as there are actually two complete fuel systems which merge at the engine selection valves. By setting these valves, engines can be run on either system. Storage facilities consist of one 120,000-gal heavy fuel tank and three light fuel tanks with a total capacity of 36,000 gal. In the light oil system, fuel is fed to the day tank from storage through a single line and then pumped to the selection valves through a cotton filter.

The heavy oil system has two day tanks, the first of which is a blending tank with fuel lines feeding from both light and heavy oil storage. Both feeder lines are equipped with meters so that fuel from either storage tank can be measured and controlled. Fuel from the blending tank goes through a centrifuge to the second day tank with the excess returning to the blending tank. A pump picks up oil from the second tank and pumps it through electric heaters and filters to the selection valves. From this point, whichever oil is chosen is pumped by the engine pump through an electric heater and edge-type filter to the injection pumps.

At present, the plant uses a No. 2 oil in the light fuel system. Light oil is used for starting and stopping engines and occasionally for regular operation. Running engines on No. 2 just prior to shutting down clears out heavy fuel, assuring quick starting. In the heavy oil system, where No. 5 fuel oil is used without blending, the blending tank in effect serves as a day tank for non-centrifuged fuel. Centrifuging removes an average of 4 lb of solid material per 1000 gal. Since excess oil pumped into the second day tank returns to the blending tank, it again passes through the centrifuge with a consequent positiveness of solids removal.

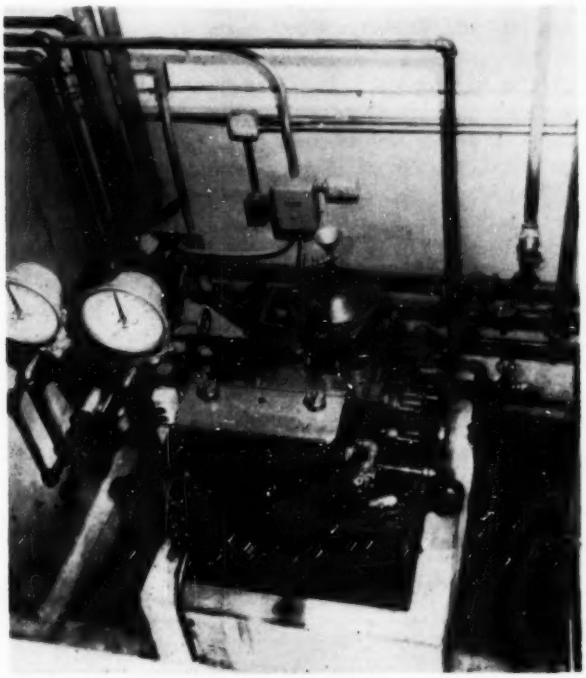
Engine cooling is of the closed circuit type utilizing, of course, treated water. Cooling water is circulated through engine jackets and shell-and-tube exchangers by motor-driven centrifugal pumps. Jacket water is used to provide heat for the heavy oil in the outdoor storage tank and in the day tank. Water lines are enclosed in the same insulation jackets as the fuel lines so that regardless of temperature extremes, pumping viscosities are easily maintained.

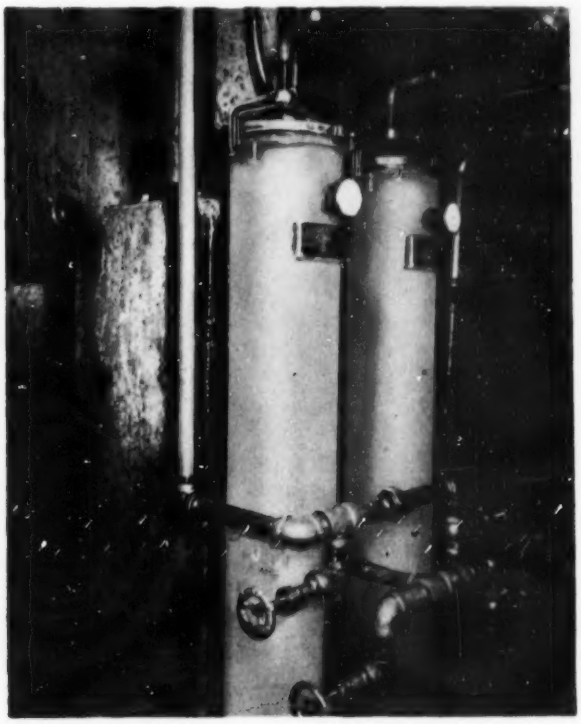
While each engine has its own jacket water system, a piping arrangement permits the diversion of heated water from an engine in operation to an engine that is off the line. This allows, with the use of auxiliary pumps, circulation of heated water for any desired period to insure that all parts approach operating temperature prior to starting. In normal operation, jacket water and lube oil are circulated by the engine pumps and cooled in shell and tube exchangers. Raw water is the cooling medium and is in turn cooled in a natural-draft cooling tower.

Engine intake air pressure is increased by turbochargers which send air into the cylinders at 3-psi pressure. Exhaust gases, after passing through the turbine side of the superchargers, discharge to a battery of silencers located at the rear of the plant.

Savings and Costs

Present fuel savings accrue from two sources: increased output in terms of kwh per gal of fuel, and lower cost per gal. Analysis of fuel consumption shows that the Worthington units average 14.4 kwh per gal on heavy oil.





Heavy fuel is put through a centrifuge (above) to remove excessive solids. Fuel is also cleaned in fuller's earth filters (right).

This figure compares with the 13.4 kwh per gal obtained by the same units with light oil. The difference is due to the higher heating value of the heavy fuel. Also favoring the use of heavy oil is the 4.1 cents per gal price differential which prevails at this writing.

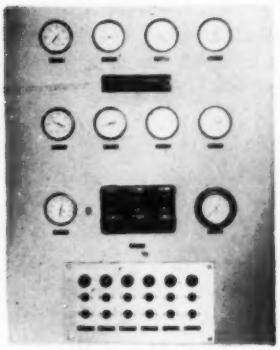
Specifically, the new engines produced in the fiscal year ended June 30, 1952, a total of 12,084,800 kwh, while consuming 705,039 gal of heavy oil and an estimated 146,247 gal of light oil. The units generated approximately 84 per cent of their total production on heavy oil, the rest on light. Fuel cost per kwh is just 5.1 mills on heavy oil compared with 8.5 mills for the same engines on light oil. Thus, the use of No. 5 fuel results in a saving of 3.4 mills for each kwh produced with the heavy oil, or a saving of $34,000 on fuel for the year.

Following are some comparative figures on fuel costs and consumption for the year ended June 30, 1952:

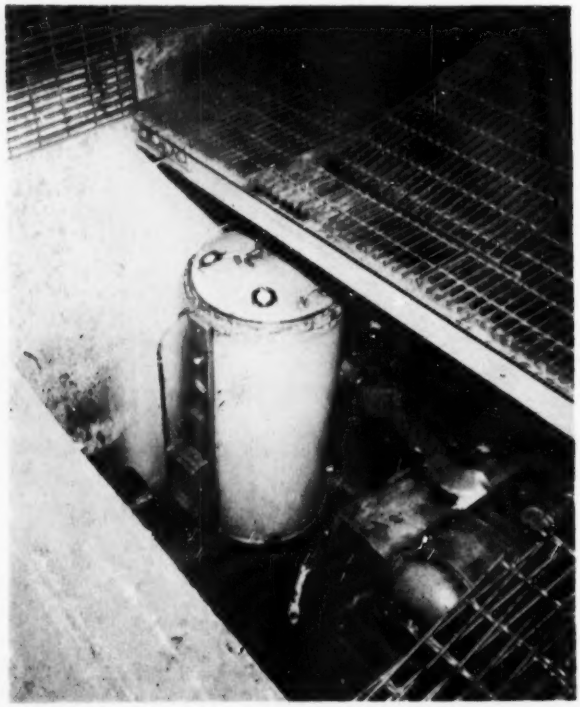
FUEL COSTS DATA

	New Engines		*Old Engines*
	HeavyOil	*Light Oil*	*Light Oil*
Kwh Generated	*10,130,000*	*1,954,800*	*2,520,000*
Kwh per Gal	*14.4*	*13.4*	*11.4*
Fuel Cost, Mills/Kwh	*5.1*	*8.5*	*10.0*
Total Kwh Generated			*12,084,800*
Average Kwh per Gal (new engines)			*14.1*
Average Fuel Cost (mills/kwh new engines)			*5.66*

It is also true that the newer engines, embodying the most recent technology, are the most efficient prime movers in the plant with regards to fuel consumption so that their fuel cost, averaging 5.66 mills for combined light and heavy oil output, is a full 44 per cent under the 10.0 mills for the older units on light oil. At current fuel prices and the production rate of the last fiscal year, this represents a saving on the new engines of more than $52,000 a year on fuel oil compared with what it would have cost at the old engine rate.



A control panel located near each engine holds gauges, auxiliary equipment controls and a compact alarm panel.



Lube oil for the Worthington engines is cleaned in a Honan-Crane purifier. A similar purifier is used in the heavy fuel system.

Summary

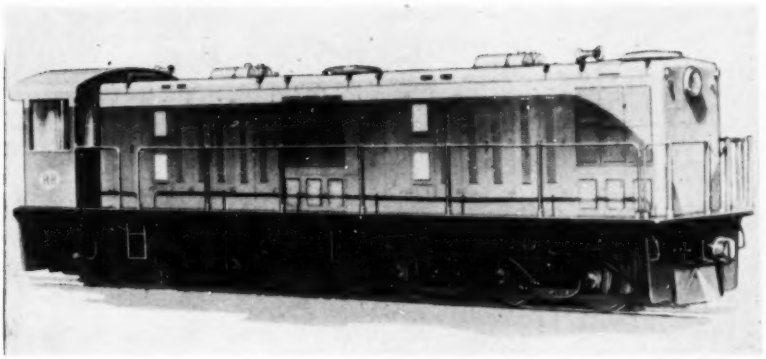
The higher heating value per gal of the heavy fuel oils, combined with the lower cost per gal, will undoubtedly mean that any additional units purchased will be designed to use such fuels. While additional problems, over and above the normal fuel problems, are admittedly present, their solution is being achieved. Most problems revolve around the fact that the higher solids content of the heavy fuel imposes additional filtration problems and also places a heavy load on the injector pumps. Cylinder liner wear is also somewhat increased.

Many of these problems have been solved by centrifuging and the use of both edge-type and cotton filters on the fuel oil. Chromium-plated piston rings, now almost standard in automotive practice, are used in the top two grooves of each piston in one engine and show excellent promise of maintaining compression and reducing oil consumption for long periods. Their use may be extended to the other two Worthington engines.

Also sure to be continued is the policy of purchasing engines that can use natural or manufactured gas as fuel. The present engines are so designed and while natural gas is not now available, the low cost of this fuel is so attractive as to preclude the ordering of anything other than a dual-fuel engine, so that Tarboro can take immediate advantage of the economical fuel if present efforts to secure a gas supply are successful.

Principal Equipment

Engines	Worthington Corp.
Generators	Westinghouse Electric & Mfg. Co.
Auxiliary lube pumps	Worthington Corp.
Lube oil coolers	Struthers-Wells
Lube oil purifiers	Honan-Crane Corp.
Lube oil	Esso Standard Oil Co.
Heat exchangers	Struthers-Wells
Cooling water pump	Worthington Corp.
Fuel oil centrifuge	DeLaval
Fuel filters	U. S. Hoffman Co.
Fuel oil purifier	Honan-Crane Corp.
Starting air compressor	Worthington Corp.
Switchboard	Westinghouse Electric & Mfg. Co.



Powered by two 12-cyl Caterpillar V-type diesels, the new 85 ton units have a total of 1000hp.

Diesels Serve Rhodesian Railways

During the latter part of this year, the newly crowned Elizabeth II, Queen of the Realm and Head of the Commonwealth, will visit Southern Rhodesia to help celebrate the sixtieth anniversary of that relatively undeveloped self-governing colonly and member of the British Commonwealth of Nations.

As Her Majesty's special train rolls across the veldt (terrain comparable to the plains country in the United States), she may see, on a siding waiting for her train to pass, a string of freight cars powered by any one of six 85 ton, 0-6-6-0, 1000-hp, 42-in gauge diesel-electric locomotives newly owned by the Rhodesian Railways, Ltd. — and manufactured by the Davenport Locomotive Division of Davenport Besler Corporation, Davenport, Iowa.

These locomotives are engaged in main line freight service and switching on the 170-mi run from Salisbury to Umtali. The chief lading on this line is chrome ore, although Rhodesia is also currently producing coal, asbestos, iron ore and limestone.

The run is made usually in 11 to 12 hours, including time on sidings to permit faster passenger trains to go through. There is nothing unusual about the 1½ to 1¾ per cent gradients. The maximum altitude is 5000 ft at Eagle's Nest.

Interestingly, the diesel fuel is brought in by sea and rail via Portugese East Africa. Despite this apparently costly fact, the diesel-electrics are proving to be highly satisfactory. Factory service personnel responsible for the initiation into Rhodesian service of these locomotives report them to be in the charge of well trained and able mechanics.

Each locomotive has a full width cab at the rear with full length walk ways on either side of the hood with end platforms, making it possible for the operator to cross over with ease from one locomotive to the other when units are used in multiple operation. Vacuum brakes are required to brake the cars but straight air brakes are used on the locomotive.

Each locomotive is equipped with two Caterpillar D-397 V-type diesel engines. These are 12-cyl engines with 5¾-in bore and 8-in stroke. Each engine is rated at 500 gross hp at 1200 rpm. Electrical equipment consists of two Westinghouse Electric type 1604C main generators, two type YG-49-D exciter auxiliary generator units, and six type 973A traction motors. These traction motors are externally force ventilated by blowers.

The two power units are in line, each driving a blower, compressor and exhauster unit. Each power unit operates individually so that should one unit fail the other would operate all accessories at 50 per cent capacity, thereby enabling the locomotive to move under its own power to the nearest repair station. Hood design incorporates four sections to enclose the power units. Each section can be removed for easy access to all parts of the power units for service or removal.

A radiator is so installed on each side of the hood that it may be removed with the hood section or left intact when the hood section is removed. The radiator cores are easily accessible from outside. Fans for ventilating the radiators are mounted in the roof of the hood, are supplied by International Engineering Company, and are V-belt driven.

Electric control panels are placed at the rear end of each power unit for easy assembly and maintenance and as an aid in the reduced use of strategic materials. The controls are conveniently located in the engineer's cab.

Air filters are supplied for cleaning the cooling air for the blowers and generators. A fuel tank of 600-gal capacity is supplied. A.A.R. automatic type "E" couplers are used. The locomotives were built to I.C.C. requirements.

Individual cylinders are provided at each wheel for the clasp brakes in order to simplify the mechanical arrangement. The use of a combined vacuum exhauster and compressor has furthered compactness and proven most satisfactory.

Principal Equipment

Engines	Caterpillar Tractor Co.
Generators	Westinghouse Electric Co.
Exciters	Westinghouse Electric Co.
Traction Motors	Westinghouse Electric Co.
Blowers	American Blower Co.
Batteries	Gould National Batteries, Inc.

An aerial view of the Radio-Relay Station at Mt. Rose, Nevada. At an elevation of 10,000 ft, this is the highest station on the transcontinental Radio-Relay System.

Automatically Controlled Stand-By Power

By V. T. Callahan*

EARLY in 1952, high winds and heavy snows downed 1600 feet of power lines, completely isolating a radio relay station at Mount Rose, Nevada. Almost immediately and automatically, the station's emergency engine-generator went into operation. Four days later, when maintenance men armed with snow shoes and "snow cats" finally reached the station, they found the engine still operating satisfactorily.

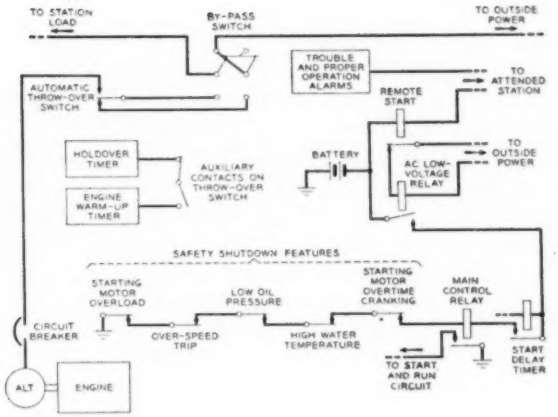
With a change of lube oil, the engine continued to carry the load without further attention until power lines were restored 10 days later. During this two-week period, people in the eastern United States continued to watch television programs from the West coast little realizing that a repeater station was operating on its emergency power unit.

Reserve Power Sources

On earlier-built carrier routes, reserve power is usually furnished by station storage batteries. During unusual commercial power outages, portable engine-generator sets are brought up by trailers. This practice, of course, requires battery reserves sufficient for period as long as 100 hours.

A few stations, requiring more operating power than can economically be furnished with such long battery reserves, are supplied with permanent, automatically-controlled engine-alternators for emergency use. In some

**Abstract of an article by the author which appeared in the January 1953 issue of the Bell Laboratories Record.*



Illustrated above is a simplified block diagram of the essential features of the automatic control system.

cases, increased power demands of the broadband systems, such as radio relay, plus isolated locations of many radio relay stations have made it economically feasible, to install automatic engine-driven alternators for the primary reserve. Storage batteries are also included, but limited to six- or eight-hour capacities. This is sufficient for the period necessary for ordinary engine repairs should they be required.

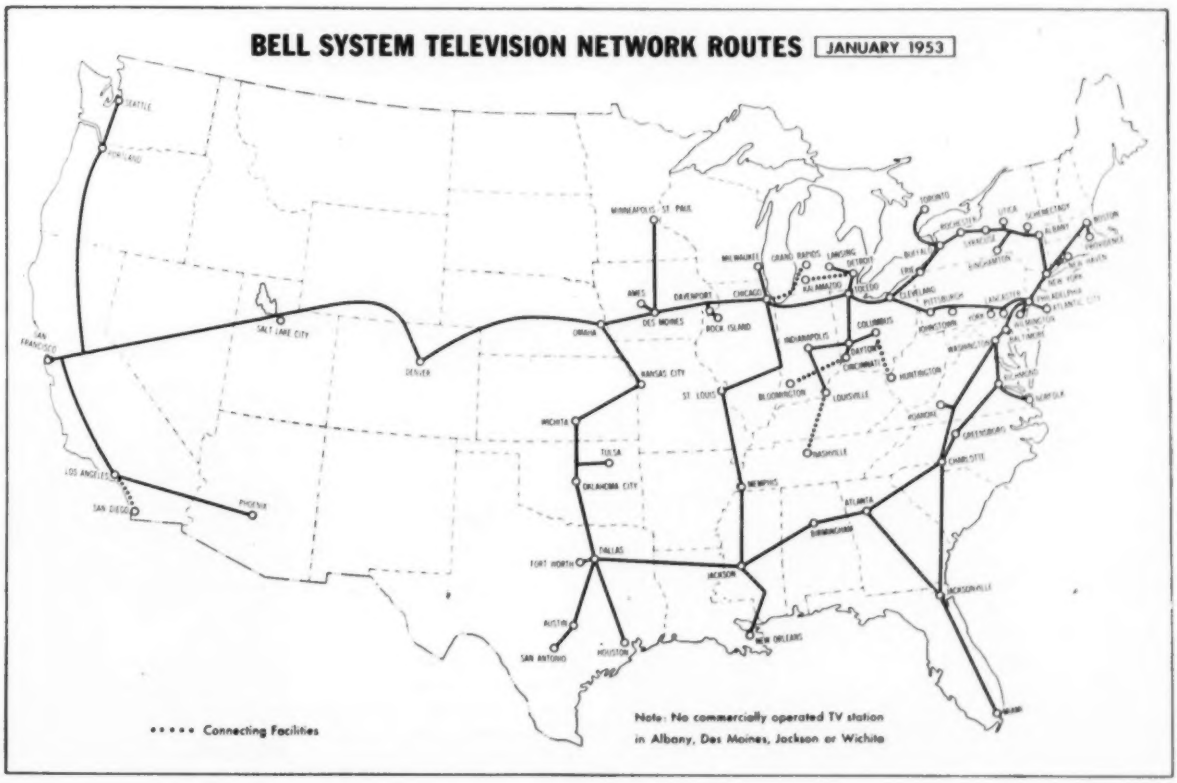
Early station installations on the transcontinental microwave radio relay system were supplied with automatic gasoline-engine sets. Later stations, west of Denver, are diesel-powered. Development of the automatically controlled diesel engines had not been completed in time for use throughout the transcontinental system. Both gasoline and diesel automatic sets have capacities of 20 to 60 kilowatts.

Automatic Operation

As repeater stations are normally unattended, and many are in isolated locations, it has been necessary to provide more elaborate controls than usually needed for commercial standby power sources. For example, to keep the engine from starting on a temporary voltage dip (which can be handled by the battery reserve), a starting delay circuit is included. This circuit requires a pre-determined length of time before functioning.

After this delay, the engine is given its final signal to start, but does not ordinarily assume the station load until after a warm-up period to improve engine operation. During this interval, station load is carried by storage batteries. At the end of this time the load transfer is made by a very fast-operating contactor. Designed to require electrical power only when transferring the load, this contactor remains mechanically locked in one position until energized. Hence interruptions of power supply due to temporary voltage variations are avoided.

When normal power service is again available after a failure, the engine continues to carry the station load for



a predetermined time to insure that the normal voltage condition is not temporary. Unless the engine has been running for some time, it continues to operate long enough to raise its temperature and thus prevent undue condensation dilution of crankcase oil. At the end of this period the fast-acting contactor again operates to connect the commercial power supply to the load. The engine then stops and the circuit is in readiness for the occurrence of the next power failure.

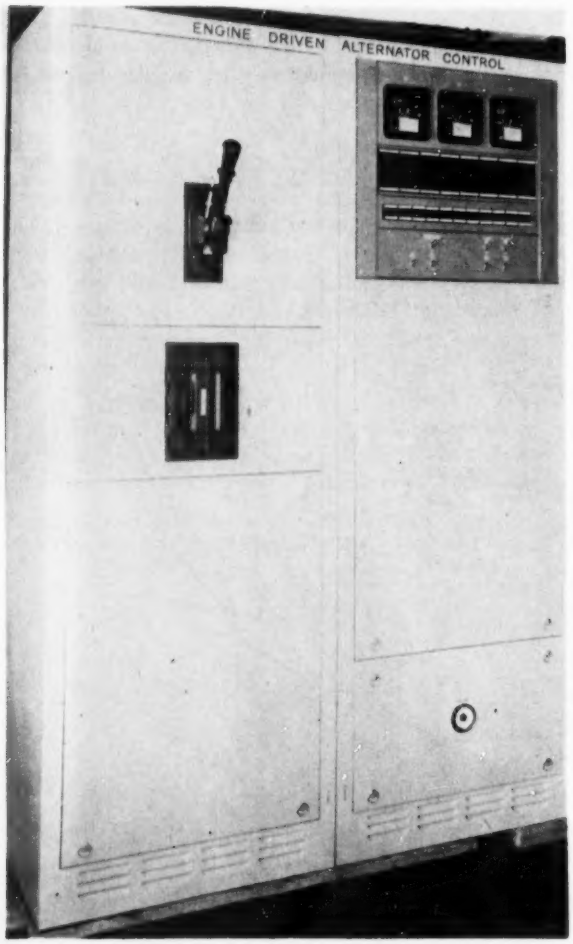
Cooling and Ventilation

Engine room ventilation in unattended stations required careful design to maintain desirable operating temperatures. Three automatically-operated shutters are provided in the air system. Air intake louvers open when the engine starts and close when it stops. Air exhaust shutters do not begin to open, however, until the radiator cooling solution reaches about 135° F. Shutter position is determined by a mechanism controlled by the coolant temperature. The exact position is changed as required to maintain the desired temperature. The third set of louvers is controlled by an engine-room thermostat. They are arranged to recirculate some of the warm radiator air if needed to maintain desired room temperature during engine operation, since engine rooms generally are not heated.

Control System

Since there is usually no attendant within a number of miles of the station, it is important, in case of trouble, to stop the engine before damage is done. If speed becomes too high, oil pressure too low, or cooling solution too hot, controls are arranged to stop the set and transmit alarm signals to maintenance people at a control center.

Should an engine fail to start during the cranking cycle, cranking is stopped after a predetermined period, to avoid complete discharge of the starting battery. This is a separate storage battery equipped with a rectifier to keep it in a fully-charged condition. Similarly, if the heavy initial inrush of starting motor current perists—as it would for example, if the bearings seized—the attempt to crank the engine is discontinued so as to avoid damage to the starting motor. Signals are also given to indicate power failure, to show when the engine set is carrying the load, and to warn that the fuel supply may be becoming low.



Twin cabinets house automatic control equipment which is furnished by the Western Electric Company.

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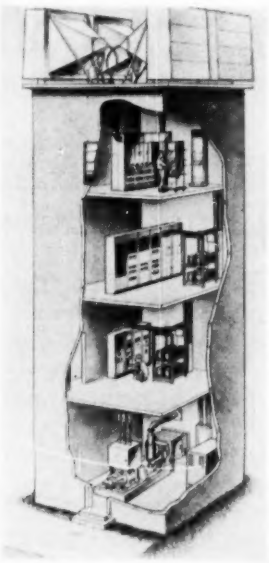

A cut-away view of a typical concrete station in the Long Lines transcontinental Radio-Relay System.

The Author, Mr. Vincent T. Callahan is a member of the Bell Telephone Laboratories power plant development group.

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To be sure that engine sets are in condition for reliable starting, arrangements are provided for exercising them each week. This may be done locally at the station, or remotely from the maintenance center whereby the engine circuit "thinks" a power failure has occurred and goes through its regular power failure cycle. Load is restored to commercial service upon completion of the cycle.

Since they are installed in unheated rooms, engine sets may be exposed to temperatures as low as minus 20° F. Tests at that temperature have shown that positive and reliable automatic starting requires a 2500-watt thermostatically-controlled heater for the cooling solution. The thermostatic switch used with this heater is set to cut off the heater when the cooling liquid is 80° to 100° F, and to turn on the heater at 60° F or lower.

Due to its radiation, in air temperatures of minus 20° F, the heater maintains an engine cylinder combustion air temperature of 45° to 50° F. The types of diesel engines used in these stations require a cylinder combustion air temperature of not less than 35° F at the start of the compression stroke so as to ignite fuel properly by the heat of compression at the end of the stroke.

Emergency arrangements are made to stop the engine by a switch at the engine or from the control panel. Switching provisions are also included to transmit normal service power directly to the load circuits, and to remove the service power from the control circuits during periods of repair or maintenance.

Diesels Furnish All Power

Three stations on the transcontinental radio relay system are in locations where no commercial power supply is available and where the provision of such a supply was economically prohibitive. For these stations, the single engine control circuit was modified so that two engines could be operated on a continuous basis. One engine operates for 12 hours, then the other for 12 hours, continuing this way for a month, without attendance. Two-engine installations have all the features that the single engines have except that no cooling solution heaters are provided since the rooms are heated.

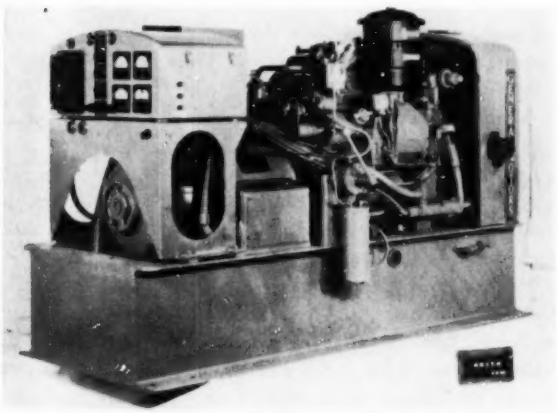
At the completion of a 12-hr. service period, the idle engine starts, running for five minutes at no-load. The load is then transferred to this engine, and the first engine shuts down. Control circuits are interlocked to prevent false or improper operation of either engine generator set. If the second set should fail to start or to assume the load, the first set will continue to run, and the failure will be reported over the alarm circuit to the control center.

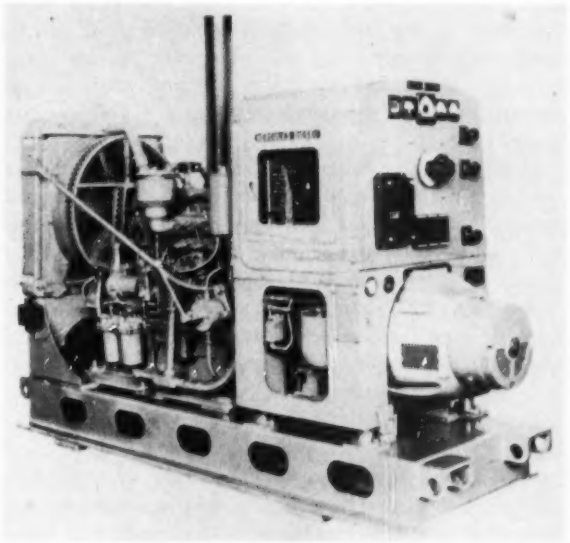
It is not practicable to provide an engine crankcase of sufficient size to hold enough lubricating oil for a month's continuous operation of the two engine-generator sets without attention. Therefore, to enable monthly maintenance, a wall-mounted tank for the lubricating oil is provided. It has pipes connecting to both engine crankcases and it also has float level valves.

To avoid the possibility of flooding the engine crankcases in case the float level valves should fail, a high-level overflow line is connected to each crankcase. This line runs to a floor tank containing a float-operated switch used to start a small electric motor-driven pump. The pump returns the oil from the floor tank to the wall-mounted reserve tank.

Summary

Development of the reserve power plants is another example of cooperation between Bell Laboratories engineers and those of outside suppliers. Through the combined efforts of these engineers, engine-alternator sets equipped with the necessary accessories for full automatic operation are now giving excellent emergency service in radio relay stations.





Typical of the engine-alternator sets used for unattended standby service on the transcontinental system are the 40 kw General Motors unit above and the 20 kw Hercules set at right.

Let Power Tools Do the Work

Power tools lessen manual effort and help take the drudgery out of arduous jobs. Result — Better, faster and cheaper work.

There are an awful lot of nuts and bolts in the average piece of machinery. When it comes to maintenance and repair work, a large portion of the time expended is devoted to these fasteners, and a lot of energy too. The worst part of this is that it is only an incidental operation to the main job. The skilled work of the mechanic can only come into play after the machinery is taken apart, and the value realized after you go through the same rigamarole in putting it back together again.

Hand-wrenching takes time and effort. Spinners and ratchets were developed to ease the condition as much as possible, but, while these tools are essential, the need is for more speed and torquing power. Nut-runners and impact wrenches are commonplace in production line operation so why not use them in the maintenance shop? Here is some data on what an impact wrench—in this case, an Ingersoll-Rand electric Impactool—can mean in a heavy equipment shop.

Economy Coal & Building Material Company of Waukegan, Illinois, has not only reduced maintenance costs but has actually cut down on the number of repair jobs through use of one heavy-duty electric impact-wrench. Savings on just two operations—tire changes and spring jobs—have totalled more than $1400 a year in labor and parts.

Economy Coal operates a fleet of 54 trucks, including 14 Ready-Mix trucks, Diamond T tractors, Hendrickson 6-wheelers, Federals, Whites, Fords, Dodges, and others. In addition, there are four Caterpillar tractors, an International bulldozer, Bay City and Lima back hoe, and a Unit mobile crane.

Maintenance Superintendent Arthur Wendt reports that the maintenance of this heavy equipment in the past, posed several serious problems. Good mechanics are scarce, and many men did not want to work on the heavy vehicles. Some jobs simply could not be done satisfactorily with hand tools.

For example, he describes the replacement of spring U-bolts as a "man-killer", an arduous job taking as much as half a day. Even then, a man could not tighten the bolts adequately by hand, and when the truck went over a curb or ditch as these vehicles do repeatedly in normal operation, the center tie-bolt sheared off, often resulting in a broken spring.

In an effort to meet these and other problems, the company put into its maintenance shop one of the new size 34U Ingersoll-Rand electric Impactools, specially designed

for such heavy-duty operations. Used on the entire 54-truck fleet and other pieces of equipment, the power tool has effected considerable savings.

The spring job on the smaller trucks took an average of 4 hours when done with hand wrenches. With the electric tool, the time was cut in half. Even more important, this repair job has been virtually eliminated. The U-bolt nuts run with the power tool stayed tight, and there has hardly been any breakage of tie-bolts and springs since the power wrench was introduced into the shop.

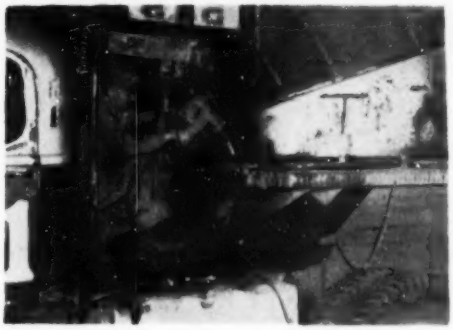
In the past, the shop has averaged 30 spring jobs a year on these trucks, requiring replacement of 30 center bolts, 6 main leaf and 10 other springs. Virtual elimination of this breakage meant a saving on parts of about $75. A saving of 2 hr on each job (with labor at $2 an hour) adds $120 to the savings. With an end to breakage, the entire job is wiped out and labor savings are actually $240. Company management is naturally interested in these dollar savings, but it is even more concerned with the reduction in time that trucks are laid up for repairs, and the increased availability of all equipment.

Here, a mechanic is using an electric Impactool to remove the 1⅛ in carrying axle main bolt on a dozer.

Other common operations in the shop were speeded to an important degree when the power tool replaced the hand wrench. Changing a big dual wheel with its pair of tires was a 45-min job with hand tools. With the impact tool, the time was cut to 20 min. This shop changes an average of four duals a day, seven days a week. At that rate, the power tool saves 608 hr a year, a cash saving of $1216 a year on labor for this one ordinary operation.

Shop personnel cited several examples of jobs which could not be done properly without the impact tool. The tool is used on all maintenance work on the tracked vehicles. For example, the front unloader bolts tend to shake loose, and on some vehicles it is impossible to swing a hand wrench. With the power tool the job is

Running up U-bolts is a comparatively easy job with an impact wrench to do the bull work. Below, we see a mechanic tightening a 1½ in nut on the front drum bearing of a Ready-mix truck.



easy. Similarly, on the Lima back hoe there are places it is impossible to get the leverage necessary to tighten bolts. Again, this problem has been solved with the power tool.

The impact tool is also utilized on stationary equipment. The plant has a block machine equipped with vibrator and all the many 1¼- and 1½-in bolts vibrate loose periodically. Run tight with the electric tool, the bolts stay tight longer and, when necessary, can be retightened with considerable saving in labor time.

Prior to the introduction of the 34U, there were no electric impact tools designed for heavy truck maintenance jobs, the very jobs where a mechanic most needed help from a power tool. It was designed to meet this need and is capable of easily handling nuts and bolts with thread diam up to 1¼ in. Like the smaller 4U and 8U Impactools, this tool incorporates an impact mechanism such that the electric motor delivers its power to the work in the form of 900 rotary impact blows per minute without transmitting any kick or twist to the operator.

Mr. Wendt finds that the power tool, by easing the tough jobs, has helped to keep his mechanics satisfied and has served to reduce labor turnover which previously had been a serious problem. The men, he says, quickly learn to use the tool and can run a nut or bolt to within 2 ft lb of the desired torque.

Tools of this sort can be effectively used in engine repair and maintenance programs to facilitate the assembly and disassembly of component parts. They will save time, effort, and hence expense. When assembling components where torque settings are critical and should be observed, the bulk of the work can be accomplished, leaving the final tensioning to be done with a torque wrench.

The BARC

DURING World War II, the 2½-ton DUKW and the LVT were the principal amphibian vehicles. Although they were used extensively and successfully in all theaters of operation, their extremely limited cargo-carrying capabilities slowed the progress of many amphibious operations. At present, the Army cannot transport any equipment weighing over five tons or exceeding the dimensional limits of cargo space available in the most modern amphibious military vehicles, from offshore to shoreside points.

Under existing conditions, such cargo must undergo waterline transfer from one transporter to another if it is to be moved beyond the water's edge. Practices of this sort produce congestion in vital beach areas, wasting both time and manpower when both are at a premium. A larger amphibious vehicle was needed.

Late in the summer of 1951 the Transportation Corp initiated a study of the design and operational feasibility of a very large amphibious vehicle.

In the pre-blueprint stages of the study several civilian consultants were called in. Among these were, Richard C. Kerr, Roderick Stevens, Jr., and Dr. Thomas C. Poulter. Mr. Kerr, chief geologist and transportation advisor for the Arabian-American Oil Company, is an expert on heavy lift desert transportation. Mr. Stevens of Sparkman-Stevens, Inc., naval architects who played a large part in the development of the DUKW, was the second consultant invited to sit in on the design discussions.

Associate director of the Sanford Research Institute, Dr. Thomas C. Poulter, was the next expert asked to attend. Dr. Poulter was the designer and construction supervisor of the Antarctic Snow Crusier used by the U. S. Antarctic Service expedition in 1939. In comparing the BARC and the Snow Cruiser, some resemblance will be noted.

As a result of the completed study, a detailed design and prototype contract was let to the Pacific Car and Foundry Company, in December of 1951.

The prototype vehicle was designated "Barge, Amphibious, Re-Supply, Cargo" in keeping with Army nomenclature. However, this was quickly shortened by all those charged with its development, to BARC.

Land Operation

On September 22, 1952 the BARC first moved under its own power. It was at this time that the unit rolled off the building ways at PC&F's Renton Plant. Power is supplied for the unit by four GM series 6-71 diesel engines each rated at 165 hp. Engines are mounted in compartments on either side of the unit adjacent to the wheels. Each engine supplies power to one wheel.

From engine to wheel, power is transmitted through an Allison Torqmatic transmission, two planetary gear

At left, the BARC is shown just after it rolled off the building ways. Here, full steering is being used to negotiate a turn. At right, a DUKW is dwarfed by the huge BARC.

Photo Courtesy U. S. Army

reduction angle drives, to a ring gear-mounted at the edge of the wheel. Transmissions have three forward speeds and one reverse, with speeds of up to 15 mph available in high gear. Through the use of synchronized air controls, shifting of all transmissions is accomplished simultaneously. In addition to all-wheel drive, all-wheel steering has been incorporated.

A pair of 30-ton hydraulic rams mounted on top of vertical king posts make up the steering mechanism for each wheel. By placing a single control in the desired position, the operator may steer in any one of three ways, normal, full or crab. A similar arrangement might be very helpful for driving your car through a congested area or for parking. If normal steering is selected, the BARC will steer in the same manner as an automobile.

Where a sharp turn must be made, full steering turns the rear wheels at opposite angles, shortening the turning radius. Crab steering, on the other hand, makes oblique movements possible, as all wheels point in the same direction. With these three methods of steering, despite its large size, overland movement of the BARC is more easily controlled.

Also, a part of overland movement is traction. To deal with varying terrain over which the unit may have to travel with a full load, tire pressures are adjustable from the cab. This is accomplished through a hub inflation system. Where soft sand or coral are to be traversed, tires can be deflated to protect them and give added flotation. Pressure is quickly raised for over-the-road travel without halting the vehicle. Tires are the largest commercially available at present and stand 10 feet high.

During the testing period, the BARC was jacked up to various heights and dropped to determine the amount of shock tires were capable of absorbing. This was an important phase as springs were found to be impractical and wheels are mounted solidly to the frame.

In comparing the Antartic Cruiser to the BARC, some resemblance is noted.

Waterborne Operation

Twin screws, located under the stern, drive the BARC through the water at a speed of 7.0 mph when carrying a 60-ton load. The two propellers are each driven by two of the same engines which drive the wheels during operation on land. However, when afloat each pair of engines drives into a gathering box, through a fluid coupling to a marine reverse gear, and out to the propeller.

The advantage of this arrangement is that speed of the engines does not have to be accurately synchronized as engines are always feeding power from both ends through a fluid coupling. Power take-offs from the main propulsion shafts furnish power to operate two bilge pumps capable of a 4000-gpm discharge. In the event of a rudder failure, the engines can be used for steering. When operating as a barge, the BARC handles with the ease of a small landing craft.

Principal Equipment

Engines	Detroit Diesel Engine Div., General Motors Corp.
Radiators	Perfex Corp.
Transmissions	Allison Div., General Motors Corp.
Power Train Assembly	Kenworth Motor Truck Co.
Main Propulsion Drives	Western Gear Works
Air Control System	Westinghouse Air Brake Co.
Fluid Couplings	Twin Disc Clutch Co.
Hydraulic Pumps and Valves	Vickers, Inc.
Air and Hydraulic Brake System	Fawick Airflex Co.

DIESEL BRIEFS

The Bull Moose—A Tractor-Dozer

Allis-Chalmers has delivered a new massive tractor-bulldozer to the U. S. Corps of Engineers from its Cedar Rapids, Iowa Works. This 4-wheel rubber-tired tractor was built for military use under a development contract with the Engineer Research and Development Laboratory, Ft. Belvoir, Va.

Engineering on the vehicle was started in January 1951, under the direction of H. W. Rockwell, chief engineer; Dale Hawk, project engineer; and Robert Johnson, winterization engineer. Construction of the "Bull Moose", as it is called, was started in March 1952 and completed in November. Since then, it has been undergoing various tests.

The vehicle measures 11-ft 7½-in high; 22-ft 9-in long; and weighs 51,300 lb with the dozer blade and control unit. The dozer blade itself is 11-ft wide and 4-ft high. The relatively low center of gravity and large size give the machine unusual stability.

Since speed and maneuverability are essential, the unit has been designed to travel at a top speed of 25 mph pulling a 65,000-lb towed load. The drive mechanism is of the 4-wheel type where front and rear wheels on each side are geared together.

DEMA Meets at Harvester

The Diesel Engine Manufacturers Association held its final meeting for professors at the International Harvester Company's Melrose Park plant on April 23. In attendance were educators from the University of Wisconsin, University of Notre Dame, Michigan State College, Marquette University, University of Illinois, Illinois Institute of Technology and Northwestern University.

Deep Rock Extends Facilities

The Deep Rock Oil Corp. has expanded its blending and packaging plant at Cushing, Okla., as a first step in a multi-million dollar modernization program for its lubricating oil manufacturing facilities. Newest installations provide for improved packaging and materials handling, a complete drum reconditioning line, greater warehouse and outloading capacity, and increased blending capacity.

Art Invades Engineer College

Philosophy will be required study for University of Detroit student engineers during their last three semesters of work, the school announced recently. Beginning with the fall term, logic, philosophy of life, and moral philosophy will be added to class schedules.

"Parade of Progress"

General Motors' new "Parade of Progress", an educational roadshow dramatizing the benefits of research and engineering, is on the first leg of its nationwide tour. Traveling in a caravan of 44 vehicles, the exhibition's official premiere was held May 12 in Dayton, Ohio.

Present plans provide for the Parade to leave Dayton May 25 for a swing through 19 other cities. A tour of southern states will follow in 1954. History of the Parade dates back to 1936, continuing each year until the outbreak of World War II.

Use Salt Caves to Store Gas

In a unique operation, estimated to entail only 10 to 20 per cent of the cost of steel storage tanks, the Sun Oil Co. of Philadelphia is providing underground storage for liquefied petroleum gas by washing out cavities in a salt formation 2000 to 3000 feet beneath its refinery in Ontario.

Butane, propane and other LPG products manufactured at the refinery will be pumped underground for use in winter when they are in high demand. Drilling into the huge salt beds that underlie the refinery site at Sarnia, the company is washing out sufficient salt to form cavities large enough to hold more than 6 million gallons of the products under pressure.

Quality Control Convention

The 7th Annual Convention of the American Society for Quality Control is scheduled to be held in Philadelphia May 27-29.

DIESEL BRIEFS

Turkey Invites Oil Exploration

The Turkish government has recently issued an invitation to established foreign oil companies to explore for oil and develop any fields that may be found. At present the country's total production is 400 bbl a day, with an importation total of about 8 million bbl of oil products a year.

Half of the 400 bbl a day produced is burned in railroad locomotives especially designed to use raw crude. The other half goes to a small plant where diesel fuel and gasoline are taken out for use at the oil fields themselves.

Diesel Uphill Battle Told

The diesel locomotive replaced the steam engine on American railroads only after an uphill battle of more than 20 years, T. A. Boyd, consultant to the General Motors Research Laboratories at Detroit, told McGill University engineering graduates recently. He stated that this railway revolution came about after highly involved and tedious mechanical experiments, campaigns to overcome prejudices, huge financial risks, and dramatic incidents of engineering salesmanship.

In the public relations field, Mr. Boyd said the pioneer Burlington "Zephyr" of 1934 was sent around the nation by the Burlington Railroad to convince the skeptics, especially railway men, that diesels were the coming thing.

Trolley Car Gives Way to Diesel Locomotive

Back in 1933, the Ohio Edison Company purchased part of an abandoned interurban trolley line which ran between its Scioto power plant and Marion, Ohio, a distance of almost eight miles. Included in the transaction was the interurban's motor-freight car.

Now, after almost 20 years of service hauling coal cars between the C & O Railroad siding in Marion and the Scioto plant, the trolley-powered motor-freight car has given way to a modern diesel-electric locomotive. The new unit takes the form of a 45-ton Plymouth 0-4-4-0 56½-in gauge locomotive powered by a pair of D326 Caterpillar engines. Each engine develops 150 hp at 1800 rpm and is connected to an individual generator.

The new unit handles 12 loaded cars, an approximate 1200-ton train load, on each trip from Marion to the power plant. Probably the greatest advantage gained with the use of the new unit is the elimination of the trolley system which is costly to maintain and expand.

GM Parts Service Expands

A new sales and service office in San Francisco has been opened by the Cleveland Diesel Engine Div. of General Motors. Added space will provide more facilities for stocking of service parts.

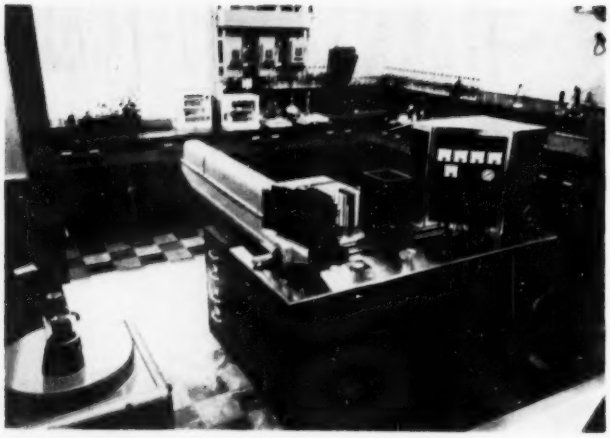
According to Thomas E. Hughes, general manager of the division, the expansion was necessary to render greater service on the West Coast where a considerable increase in the use of the company's engines in Washington, Oregon and California are being looked forward to. Charles C. Cheevers will continue in charge of West Coast sales and services.

Bosch Licenses French Firms

American Bosch Corp. of Springfield, Mass., announces it has reached an agreement with La Precision Mecanique and Societe Industrielle General de Mecanique Appliquee, both of Paris, France, licensing them to manufacture and sell the American Bosch type PSB single-plunger, multi-cylinder diesel fuel injection pump.

Detergents To Recover Oil

Detergents, of composition similar to those used in the dishpan and washtub, can be used in the nation's oil fields to produce more oil, research scientists have discovered. Tests in the Bradfield field of Pennsylvania indicate that the value of additional oil produced is twice the cost of the detergents or "wetting agents". By this method, the chemicals are added directly to water injected into the earth under pressure to drive oil to existing producing wells.



The Spectrograph as a Maintenance Tool

Fig. 1 Baltimore and Ohio spectrographic laboratory.

A progress report on the development of the spectrograph as a means of safely stretching maintenance periods.

These developments in the technique of spectrographic analysis of diesel engine lubricating oil were brought out in a two-day Symposium on the subject sponsored by the American Locomotive Company, Schenectady, New York. It represents their work and that of several major railroads that cooperated with them. The Symposium was attended by 86 representatives of 43 railroads in all parts of the United States and Canada.

The material to be presented here was abstracted from the full proceedings of the Symposium on the basis of maximum interest to maintenance personnel. Considerable of the material presented at the Symposium concerning background, techniques and methods, is not included. The main purpose here is to indicate results.

Both Alco and the participating railroads are to be congratulated for their assiduous work in this relatively unexplored field—the use of the spectrograph as a maintenance tool.

What is a Spectograph?

When radiant energy is passed through a dispersing medium and is then brought tc a focus, an image called a spectrum is produced. The images falling on a photographic plate appear in the form of lines, and those characteristic of the various elements always fall in the same position. Experts in the field are able to identify the elements and determine the amount quantitatively.

Briefly, the spectrograph as used in railroad applications, is a device that makes a photographic record of the various metallic elements found in lubricating oil samples removed periodically from the diesel engine crankcase. The sample is burned in an electric arc to produce the radiant energy. Dispersion takes place in a quartz prism and the spectrum is focused on a photographic plate. Analysis of the spectrum photograph yields a quantitative indication of the metallic elements present in the oil sample.

What Are We Trying to Do?

It is postulated that interpretations of the relative quantities of these metallic elements would provide an understanding of the specific conditions of many engine components such as pistons, piston rings, cylinder liners, and bearings. Displaced metal will be present in the lubricating oil and if it can be determined what constitutes a normal build-up due to wear, a threshold for normal operation will be established. Departures from this norm will be indicative of incipient or actual trouble.

A specific approach to the practical use of the spectrograph is seen in Table 1. Mr. J. A. Levens, petroleum chemist, Baltimore and Ohio Railroad, presented this chart as being typical of their objectives in spectrographic study.

What Are We Looking For?

Mr. H. R. Sennstrom, research and testing engineer, American Locomotive Company, stated that for the Alco Model 244 engine it had been concluded that a minimum of six elements must be determined spectrographically to evaluate engine condition. These elements are lead, copper, iron, chromium, aluminum, and silicon.

Lead and Copper—indicate bearing conditions. Showing of lead in the spectrographic analysis of an oil sample indicates overlay wear—the overlay being 90 to 95 per cent lead, the balance tin. Showing of copper shows wear of the intermediate copper-lead layer of the trimetal bearings.

Iron—is the indicating element for detection of unusual conditions in many engine parts. Principal wearing surfaces include piston rings, crankshaft journals, gears, etc.

The Baltimore and Ohio Railroad Company
Test Department Baltimore 23, Md.

QUESTIONS TO BE ANSWERED

1. What is a typical spectrographic analysis of new diesel lube oil?
   a. Does reclaimed diesel lube oil have a similar spectrographic analysis as its corresponding new oil?
2. What would be considered a typical spectrographic analysis of used diesel lube oil?
   a. Will the spectrographic analysis of used oil differ greatly with different makes of engines, operating on different brands of oil and in different types of service?
3. What concentrations of various elements indicate abnormal engine operation or excessive wear?
4. Will the spectrograph be an aid in determining the causes of various engine deposits?
5. Can the expenses of installing and operating a spectrograph be justified by improvement in diesel engine operation and maintenance?

Engine Hours ➔	0	100	200	210	220	240	300	320	400	500
Wear Elements	*Parts Per Million*									
Lead	1	4	4	½ lb. dirt added	6	3	10	21	2	2
Silicon	3	4	2		19	6	5	4	4	4
Iron	4	5	5		22	9	12	11	15	22
Chromium	4	5	4		7	4	5	4	4	3
Aluminum	1	2	1		17	6	3	2	1	1
Copper	1	5	6		6	4	10	8	4	3

Table 3 (above) Spectrographic detection of the effect of dirt in a laboratory engine.

Table 1 is shown at left.

Table 2 (below) Spectrographic analyses showing normal engine operation.

Date of Sample ➔	11/14	11/25	12/9	1/12	1/20	2/3	2/20	3/2	3/20	3/31	4/13
Pentane Insoluble	.01	.01	.02	.02	.01	.01	.01	.04	.01		
Ash, per cent	.45	.46	.40	.44	.40	.40	.47	.45		.32	.46
Lead	1	1	2	1	2	1	1	1	1	1	1
Silicon	7	2	2	2	4	2	1	5	7	1	1
Iron	13	6	7	7	16	12	5	7	12	7	6
Chromium	1	1	2	2	3	1	1	1	2	2	1
Aluminum	1	1	1	1	2	1	1	1	5	1	1
Copper	3	3	2	2	2	2	1	2	4	2	1
Date Reported	11/29	12/10	12/31	1/21	2/8	2/11	3/3	3/11	4/3	4/11	4/22

With so may different sources for iron wear products, a combination of elements must be looked for to detect the source of trouble.

Chromium—is an indicator for distress in a chromium-plated liner, and can also indicate a water leak into crankcase if the cooling water is treated with chromates.

Aluminum—indicates wear in the ring grooves or other parts of aluminum pistons.

Silicon—is generally considered the best indicator of dirt, particularly of air-borne dirt. The principal source is the air being supplied the engine and is dependent in quantity upon the degree of air-filter maintenance. Since a considerable amount of sand is used in all locomotive operation, sand or silicon dioxide represents the principal source of dirt.

Silver—is considered an important indicator for the engine of another builder (EMD), as its presence in oil would indicate wrist-pin bushing wear.

Combinations Are a Clue

It is frequently necessary to look to combinations of elements to understand the condition within an engine. High iron is typical of excessive wear of gear trains. High iron together with high copper and lead indicates probable excessive wear of crankshaft due to some bearing difficulty. High iron together with high chromium and high aluminum indicates ring difficulty involving excessive wearing of rings, cylinder walls and pistons.

High chromium alone is generally interpreted as a water leak; but high chromium and high iron in combination generally indicates ring and liner wear. These phases of interpretation are further described as examples of locomotives in various difficulties are given.

Pentane Insoluble Test

One physical analysis of the lubricating oil is used as an aid in interpretation of sample analyses. Since iron can come from so many different sources, explanation of high iron value is sometimes difficult. If the iron represents excessive ring wear, there usually is resultant blow-by of combustion gases past the rings and into crankcase.

The best indicator for such blow-by into the lubricating oil is the pentane insoluble test. This is a standard ASTM procedure and is a very simple test. It is a measure, in effect, of the amount of blow-by. From their experience, Alco is not concerned with values below 0.20 per cent pentane insoluble.

Laboratory Tests

Alco conducted a series of laboratory tests of a full-scale Model 244 12-cyl diesel engine, fitted up substantially as a standard engine, for the purpose of establishing the correlation between quantitative values of various elements and engine conditions. A 1000-hr run was made on this engine, with samples removed from the crankcase for spectrographic analysis every eight hours.

Quite a bit was learned about water leaks by deliberately adding chromate-treated water to the crankcase. The effect of dirt on engine condition was seen by adding dirt to the air stream entering engine and, following spectrographically the resulting damage, some details of which are related further on.

Field Samples

During the summer of 1951, Alco started a sampling program with a few of the railroads to establish base

Date of Sample →	11/10	11/24	12/6	12/15	12/30	1/12	1/25	2/15	3/4	3/22	4/2	4/12
				Pick-Up Metals, Parts Per Million								
Lead	5	3	5	Engines flushed and filters renewed.	6	7	13	8	10	28	14	12
Silicon	3	6	22		3	4	6	5	9	10	6	8
Iron	17	19	58		14	18	31	29	50	56	67	95
Chromium	1	1	9		2	2	4	2	5	6	10	31
Aluminum	1	1	3		3	2	3	1	4	4	3	5
Copper	4	2	7		2	2	1	3	2	3	4	3

Table 4 Spectrographic detection of the effect of dirt in a locomotive engine.

Date of Sample	9/2	9/13	9/28	10/11	10/18	10/23	11/11	11/25	12/9
Pentane Insoluble	.01	.01			.05	.01	.01	.01	.17
Ash, per cent		.50	.52	.46	.46	.49	.44	.41	.44
Lead	6	4	5	6	7	18	30	44	99
Silicon	4	8	3	5	4	1	1	2	1
Iron	12	19	16	12	14	17	14	21	19
Chromium	1	1	1	1	1	1	1	1	1
Aluminum	1	2	2	1	2	1	2	1	1
Copper	5	12	9	7	6	6	6	7	13
Date Reported								12/10	12/28

Table 5 Spectrographic detection of incipient bearing trouble.

Date of Sample	12/10	12/19	1/9	1/15	1/21	2/6	3/27	4/9	4/21
Pentane Insoluble	.02	.02		.04	.01	.01	.03		
Ash, per cent	.27	.28	.28	.29	.28	.24	.30	.32	.30
Lead	13	11	27	23	13	33	2	12	36
Silicon	2	2	3	2	2	2	5	1	1
Iron	28	31	38	28	24	35	13	12	18
Chromium	2	2	3	2	2	3	1	1	2
Aluminum	1	2	2	1	1	1	1	1	1
Copper	2	2	2	2	2	1	5	5	5
Date Reported	12/13	12/20	1/14	1/21	1/24	2/11	4/2	4/18	4/25

Table 6 Spectrographic detection of bearing corrosion.

lines under actual operating conditions. A few months later a broader field of application of this investigation was undertaken, perhaps stimulated somewhat by some temporary bearing troubles. As the research investigation was extended the sampling program grew, until at the time of the Symposium, Alco was testing lube oil samples from 850 locomotives twice per month in cooperation with more than 20 railroads.

Analysis of Normal Operation

As a basis for answering Question No. 3 in Table 1, let us see some of the results of Mr. Sennstrom's test to determine normal operation.

Table 2 shows a series of analyses made of the lube oil samples from a normally operating engine.

During the five months period, all values for the various indicator elements remained consistently low. Some variations shown are due to the addition of relatively large quantities of make-up oil which upset the spectrographic continuity.

Experience indicates that after a considerable charge of make-up oil, it takes about 5000 miles of operation before the levels of element content can be expected to regain their former stable position. The effect of a considerable charge of make-up oil can be noted in the samples of November 25, February 20, and April 13. In each of these cases all values dropped to virtually minimum values.

Effect of Dirt on Engine Wear

Results of some spectrographic analysis of lubricating oil taken from a laboratory engine before and after the deliberate injection of dirt into the engine are given in Table 3.

During the first 200 hr, all indicator elements were found in relatively small amounts. After 210 hr of normal operation, ½ lb of standardized Arizona road dirt was added to the engine over a 2-hr period at the supercharger inlet. It was made certain that no additional dirt got into this engine after this time.

It is surmised that the dirt damaged the upper rings first. As the upper rings continued to operate in the damaged condition, particles worn from their surfaces worked downward through the assembly and caused damage to the lower rings and pistons. Some time after the dirt had been introduced, the lead value started to rise, indicating scratching of the lead-tin overlay of the bearings. After 500 hr of engine operation, it was necessary to stop tests on this particular engine because blow-by was excessive.

The hypothesis that when an engine receives a charge of considerable dirt, a chain reaction is started, the full effects of which do not develop until some time later but is progressive from first damage to rings, then to liners, pistons and ultimately to bearings, was not only proven by this laboratory test but was also corroborated by actual cases in locomotive operation. The information shown in Table 4 is such an example.

The two samples of oil taken in November indicated that the engine was operating in good condition. The sample taken December 6 showed silicon-22 ppm, which is considered very high and represented a slug of dirt entering the engine. At the same time high iron and moderately high chromium were noticed, indicating the beginning of ring and liner difficulty.

On the basis of the December 6 sample anlysis, the railroad, at request of Alco, removed the lubricating oil, flushed engine, put in a full charge of new oil, and renewed filter elements on December 15. Based on the April 12 sample analysis, it was found necessary to remove the engine from service since the damage had

Lube Oil Brand	Spectrographic Analysis, Parts Per Million					
	Lead	Silicon	Iron	Chromium	Aluminum	Copper
A	2.21	2.63	9.70	1.47	1.32	2.26
B	3.68	2.32	16.71	1.92	1.56	2.05
C	13.50	3.27	27.33	2.59	2.15	2.92

Table 7 (above) Average normal metal contents of crankcase samples as affected by lubricating oil brand.

Oils →	BRAND A	BRAND B	BRAND C	BRAND D	BRAND E	BRAND F
Additive → Metals	Ba, K Na, P Zn, Ca(Tr)	Ca Ba Na	Ca P	Ca, P Zn Na	K, Na P Ba (Tr)	Ba P Na
	Pick-Up Metals, Parts per Million					
Silver	.02	.01 –	.01 –	.02	.01 –	.01 –
Tin	1 –	1 –	1 –	1 –	1 –	1 –
Lead	1 –	1 –	1 –	1 –	1 –	1 –
Iron	10 –	10 –	10 –	10 –	10 –	10 –
Chromium	1 –	1 –	0	0	0	0
Silicon	0	1 –	1 –	4	5	2
Aluminum	1 –	1 –	0	1 –	3	1 –

Table 8 (right) Typical spectrographic analyses of new oils.

reached a point where a serious breakdown could be expected. On disassembly, rings were found severely worn, the liners were scored, and the overlay of the bearings very seriously scratched, necessitating renewal of all of these parts.

The effort to save the engine from damage resulting from the dirt by flushing and cleaning of engine was unsuccessful and no way is yet known of overcoming this difficulty except by continuous satisfactory air-filter maintenance.

Detection of Bearing Trouble

The spectrograph can play a very important part in the avoidance of serious engine breakdowns due to bearing difficulty. Table 5 shows an excellent example of a case where spectrograph analysis avoided serious bearing trouble which could have caused crankshaft scoring.

The samples were from a freight locomotive and during this period up to the time of sample of October 18, the engine was in good condition. (The September 13 sample copper value of 12 ppm represents one of the frequent atypical results for which there is no ready explanation.) Sample of October 23 gave the first hint of bearing trouble when the lead value suddenly jumped to 18 ppm from 7 ppm of the previous sample five days before. Sample of November 11 showed lead had risen to 30 ppm although there was no rise yet in copper value.

Based on sample of November 25, reported on December 10, Alco requested the railroad to remove the engine from service for bearing inspection. It is interesting to note that the December 9 sample analysis showed an increase in lead from 44 to 99 ppm, and in copper from 7 to 13 ppm since November 25. Upon inspection, definite bearing trouble was found which could easily have caused a scored crankshaft had the locomotive operated a short time longer.

Corrosion by Lube Oils

The spectrograph has proved to be very valuable in detecting corrosion of copper-lead bearings long before any serious difficulty is experienced. Table 6 represents typical data.

Examination disclosed a condition relative to the quantity of lead found. All other elements remained relatively constant and no other difficulty was occurring in this engine. Upon inspection about May 1, the bearings from this engine were found to have been seriously corroded by the lubricating oil in question.

Many investigators have reported a belief that different brands of lubricating oil play an important part in different rates of engine wear in normal operation. The remarkable ability of the spectograph to detect small changes in wear rates may help in determining to what extent this is true.

Table 7 presents average values of spectrographic analysis of many locomotives lubricated by different lubricating oils, identified as brands A, B, and C. In each case, approximately 50 locomotives are represented, with not more than 10 from any given railroad. Passenger, freight and road-switching operations are included in this data. In each case, five consecutive spectrographic analyses were included from each locomotive so that the final results represent average values on each of the three lubricating oils, based on approximately 250 samples removed from 50 locomotives.

Careful attention must be placed on the quantity of silicon present as representative of the amount of dirt getting into these engines. Despite general similarity in silicon values, we find ratios of 1:2:3 roughly for the iron content, and 1:2:6 for the lead content. The wide divergence from average lead values in oil brand C can be explained, as it has been proven to be corrosive to copper-lead bearings.

	BRAND A			BRAND B			BRAND C		
	New	Good Reclaimed	Rejected Reclaimed	New	Good Reclaimed	Rejected Reclaimed	New	Good Reclaimed	Rejected Reclaimed
	Pick-Up Metals, Parts Per Million								
Silver	.02	.01 –	.02	.01 –	.01 –	.02	.01 –	.015	.02
Tin	1 –	1 –	1 –	1 –	1 –	1 –	1 –	1 –	1 –
Lead	1 –	1 –	0	1 –	1 –	1 –	1 –	1 –	95
Iron	10 –	10 –	43	10 –	10 –	60	10 –	10 –	110
Chromium	1 –	0	1	1 –	0	1 –	0	1	6
Aluminum	1 –	1 –	7	1 –	1 –	1 –	0	1 –	10
Silicon	0	0	4	1 –	1 –	1 –	1 –	1 –	4

Table 9 Typical examples of good and bad lube oil reclamation.

However, it can not be explained why there should be such a wide divergence in the iron wear rates unless it is agreed that oils have different lubricating or wear-protecting qualities. The limited amount of evidence presented so far as to the effect one brand of oil has on bearing corrosion and rates of wear as compared with another, leaves room for much more investigation and more conclusive proof.

"In analyzing these data," Mr. Sennstrom said, "you will recognize that we have carefully chosen cases where single difficulties were evidenced individually. Naturally in many cases, there are different combinations of difficulties that become almost impossible to interpret. However, as we have gained in knowledge and experience, we have been able to interpret correctly a larger percentage of the time."

Reclaimed vs New Oil

Mr. Levens, Baltimore and Ohio Railroad, exhibited sample analyses, relating to his questions No. 1 and No. 2, made of each of six brands of new oil used on the railroad. Results are shown in Table *8*. Note (1) that pick-up metals (wear elements) are all relatively low, and (2) individual brands of oil have characteristic additive metals. With this information it can readily be determined whether the oil in crankcase is a mixture by identification of the additive metals.

It has been the practice, on the Baltimore and Ohio, to reclaim drainings and use the reclaimed and refortified oils in exactly the same way as new oil. It was desired to find out if the reclaimed oil was spectrographically equivalent to new oils. Results of spectrographic analyses of reclaimed oil of three brands as compared with the metallic values of the same oil when new are given in Table *9*.

The brand A rejected batch, with 43 ppm iron, was reprocessed by using more contacting clay and better mixing, after which it was accepted as good reclaimed oil as indicated in the middle column. Brand B rejected batch, showing 60 ppm iron, was also reprocessed and accepted. Brand C rejected batch, with 95 ppm lead, 110 ppm iron, some chromium, aluminum and silicon, showed a poor attempt to reclaim oil. This batch was reprocessed, but the result was unsatisfactory and the contracting firm handling the reclamation bought the oil for its own use. The same brand of oil has been successfully processed in other plants and in the railroad's own plant.

Oil Brands and Engine Types

To ascertain to what extent the spectrographic analysis of used oils differ with different engines operating on different brands of oil and in different types of service, it was necessary to set up a series of tests the results of which was indicated in Table *10*.

While these are called typical spectrographic analyses, the concentrations vary as to limits within which engine operation is considered satisfactory. Apparent indication from the values shown is that EMD engines can tolerate larger quantities of wear metal in the lube oil than other makes of engines listed. No appreciable differences with different brands of lube oil were noticed.

Pick-Up Metal Concentration Limits

Information on this subject was given in some detail in both tabular and narrative form. One case in particular was cited where information sought was found the hard-way—by an unexpected engine failure. The start of checking on a control engine showed a lead value of 100 ppm on June 18, and again on July 23, and 98 ppm on August 2. On August 5, the engine failed because of main bearing troubles. Two things were learned from this experience: (1) that 100 ppm for lead is significant of potential bearing failure, and (2) that when a lead value of 100 ppm or build-up towards that figure is found, this is a warning to be heeded. In later cases, with an oil known to be less corrosive to copper lead bearings, the warning value for lead was found to be considerably lower than 100 ppm. It is likely that there is some time (it was two months in this case) to take corrective action to prevent a failure.

In presenting Table *11*, Mr. Levens admitted that he was "going out on a limb", but he felt from experience that limits indicated are approximately correct for their sprectrographic technique. He also feels that regardless of the limits, any sudden increases in wear metal concentration should be carefully considered.

Analyzing Causes of Deposits

One example cited was the results of tests to confirm that engine intake air was the source of abrasive particles

Table 10 (below) Typical spectrographic analyses of used diesel lube oil from various makes and types of engines.

Engine Make→	*EMD Passenger*	*EMD Freight*	*Alco Freight*	*Baldwin Freight*	*Alco Switcher*	*L-H Switcher*
	Pick-Up Metals, Parts Per Million					
Silver	.01 – to .4	.01 – to .4	.01 – to .3	.01 –	.01 – to .3	.01 – to .3
Tin	1 – to 8	1 – to 8	1 – to 1.5	1 – to 1.5	1 –	1 –
Lead	1 – to 35	1 – to 45	1 – to 15	1 – to 15	1 – to 10	1 – to 10
Iron	10 – to 100	10 – to 100	10 – to 20	10 – to 20	10 – to 40	10 – to 40
Chromium	1 – to 5	1 – to 5	1 – to 5	1 –	1 –	1 –
Silicon	1 –	1 –	1 – to 10	1 –	1 –	1 –
Aluminum	1 – to 8	1 –	1 – to 3	1 –	1 –	1 –

Table 11 (right) Significant pick-up metal concentrations indicative of excessive wear.

Element	*Concentration, ppm*	*Probable Sources of Metals*
Silver	0.5	EMD silver bushing
Tin	5	Main bearings
Lead	100	Main bearings
Copper	10	Main bearings—commutator dust
Iron	100	Ring wear—air borne dirt
Chromium	10	Alco cyl. liner—water leak
Silicon	10	Air-borne dirt
Aluminum	——	Alco piston wear

Wear Elements	9/25	11/10	2/25	3/5	3/14	3/20
Pb	2	14	70	12	13	7
Si	40	60	4	3	2	4
Fe	41	38	32	34	27	12
Cr	19	5	1	2	1	1
Al	19	17	2	4	1	2
Cu	4	3	3	3	3	2

Table 12 Test results of Engine 6880 on the Southern Railway.

Wear Elements	9/29	3/1	3/7	3/14	4/1
Pb	11	41	15	9	2
Si	2	6	4	3	5
Fe	20	60	50	22	22
Cr	1	7	3	2	6
Al	1	3	2	2	2
Cu	2	7	6	3	2

Table 13 Test results of Engine 6881 on the Southern Railway.

found in main bearing overlays. Deposits were collected progressively from the engine room, throughout the engine, and on the main bearings. The high silica and iron found indicates the abrasives were air-borne and that most entered with the engine intake air. A smaller undetermined amount entered under loose or poorly fitted head covers.

Some Field Results

Incidents of particular interest to the beginner in this field of investigation, as well as some convincing test results were described by L. S. Crane, engineer of tests, of the Southern Railway.

For the first two or three years of investigation, spectrographic analyses of lube oil samples was done by an outside laboratory. For about a 5-month period, sampling from some 50 engines, more or less regularly, had not produced any values to excite the suspicion of those interpreting the results.

Then one analysis showed 1190 ppm of iron when previous values of iron had been running from 50 to 60 ppm. The mechanical people were asked to take a look at this engine, which was done, and some very serious bearing trouble was found. The crankshaft was being ground away and a failure was very evidently imminent.

After continuing this work with samples from the same 50 engines for several months, a sample from another engine suddenly showed copper-500 ppm and lead-300 ppm. The engine was examined but no trouble with main or connecting rod bearings could be found. The copper-lead bearings on the stub shafts at the accessory drive end were next suspected. Inspection at this point revealed that all of the bearing metal was gone and the stub shafts were being worn away.

Some of the test results shown in Tables *12* and *13*, actually are from Alco's laboratory, as the Southern was cooperating in Alco's field tests and paralleling their tests.

Referring to Table *12*, note the relatively high silicon value on September 25 and a still higher value of 60

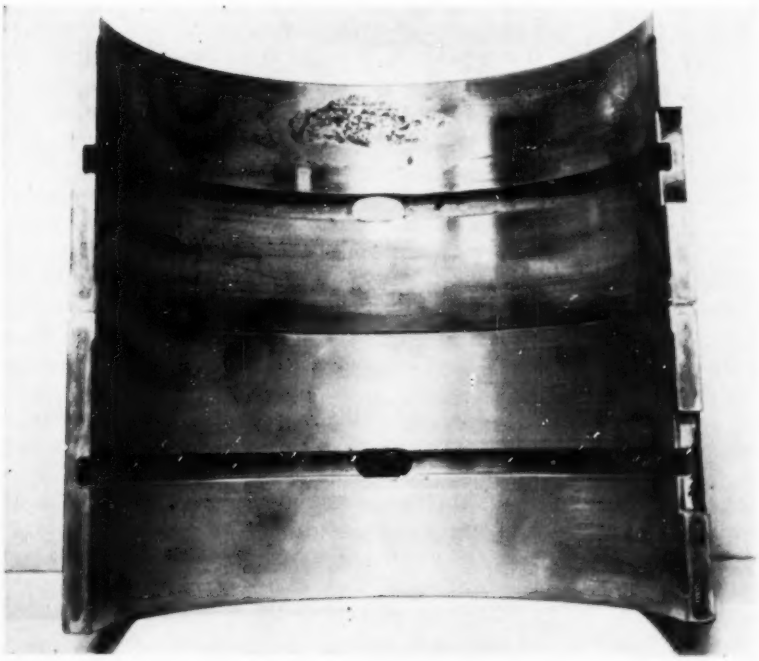


Fig. 2 Defective main bearing, Engine 6880 (Southern).

Fig. 3 A sample being placed in an electrode in the B & O laboratory.

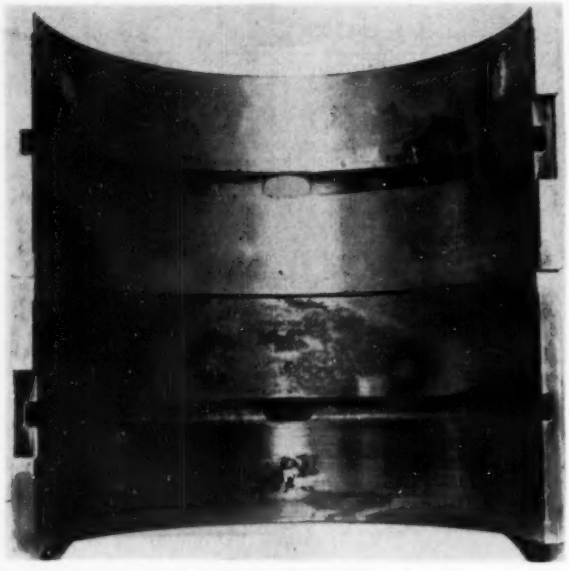


Fig. 4 Defective main bearing, Engine 6681 (Southern).

ppm on November 10. Seeing the high lead of 70 ppm on February 25 (sampling was not regular), an engine change-out and examination was recommended and performed. After a oil change, the lead and silicon values dropped back to normal. A defective main bearing found at this time is shown in Fig. *2*.

Referring to Table *13*, the first oil sample analysis on Engine 6881 on September 29 indicated about normal operation, but when analysis of the sample taken March 1 was available, the increase in the several values, particularly lead and iron, led to belief that engine was in for immediate trouble and inspection was recommended by laboratory. After oil was changed and bearings replaced, the ppm values dropped back to normal. A defective main bearing from this engine is shown in Fig. *4*.

Mr. Crane cited and illustrated several similar instances where spectrographic analysis had resulted in detection of trouble before final failure occurred. Those given however, are fairly typical.

What Does It Cost?

Cost of equipment as reported by three owners of spectrogrophic apparatus was $20,000, $25,000, and $35,000. The lower figure apparently did not include the cost of providing air conditioning necessary to control temperature and humidity or electric equipment required for voltage resulation and control, while the other two higher figures seem to include such costs. It is reported now possible to purchase spectrographic equipment which is simplified yet adequate for railroad use in the price range of $12,500 to $13,500.

Operating expense of spectrographic work is reported by one railroad representative to be $4 per analysis, composed largely of payroll expense of laboratory personnel and a general railroad overhead of 100 per cent expense. For a railroad which owns 1000 engines from which oil samples are analyzed twice per month, the cost is $96,000 for 24,000 analyses—approximately $100,000 annually.

This same representative said that they had been successful in predicting 23 potential crankshaft failures while missing in four cases. More experience will, it is hoped, reduce the percentage of cases missed but perhaps not eliminate such cases entirely. More efficient engine operation from detection of defective rings, liners, pistons, and bearings will add to savings.

If developments prove that heavy overhauls can be scheduled at longer intervals according to wear conditions inside the engine instead of an arbitrary mileage or months period, additional savings will accrue. Decision as to whether initial cost of spectrographic equipment and current expense necessary is justified, is one which every railroad management will have to make, based on their own situation.

Summarizing

It was clearly shown during the 2-day Symposium that the spectrograph can be a valuable tool for preventive maintenance. Its use is applicable to diesel engines of all makes—not to Alco's alone. Mr. Seniff, engineer of tests, Baltimore and Ohio Railroad, commented in part, "It is, to my way of thinking, the best guide in establishing a level of maintenance of diesel lubricating oil and air filters in all locomotives."

At least seven major railroads had in operation, or on order, complete spectrographic testing outfits for preparing and testing their own samples. Improved laboratory and sampling techniques developed over the past several years, combined with more accurate interpretation, had increased the efficiency of spectrographic analyses to the point where a majority of participating roads were reporting considerable savings in maintenance, repairs, and prevention of costly breakdowns.

However, emphasis is placed on the importance of recognizing the spectrograph as a maintenance tool of great potential but that it is not yet in a position to take the place of any present inspection and maintenance procedure.

Development has been going on for several years, but at an accelerated rate during 1591-1952. Laboratory men of the individual railroads, locomotive builders, and some of the oil companies have developed methods to suit their own needs as they see them. While each method may produce results yielding to individual interpretation, a common basis for comparison among all the methods is lacking.

A real need for the immediate future is to find a suitable technique acceptable to all. This will permit different laboratories to compare results directly by a more uniform standard of interpretation. It was suggested that a committee be formed for the purpose of investigating the possibilities of arriving at some standard technique. This has been done and an ASTM committee is now actively working on this problem and is making good progress.

DART'S NEW 60-TON DUMPER

Dart's latest addition takes the form of an off-highway dumper with some new designs departing from the usual "scaling-up" methods.

SINCE the days of the Conestoga Wagon, trucks have been growing larger. Perhaps the main reason for this growth is the relentless effort to move more material faster and at lower costs. Power shovels too have grown larger over the years, becoming over-size in proportion to present model off-highway trucks. As the need for greater capacity arose, truck manufacturers met the need by "scaling-up" their present designs.

With this in mind, and anticipating that the industry has reached its limit on the "scaling-up" of conventional designs, the Dart Truck Company has designed and built the Model 600. This new 60-tonner is strictly an off-highway rig incorporating some interesting design features.

For example, mountings for the two Model 8 DAS 1125 Buda diesels (Cummins NHRBS 600 or Waukesha WAKDS and WAKR optional) are a departure from the conventional in truck application. Engine compartments are located one on either side, underslung from the chassis just forward of the rear axles. Advantages of underframe mounting are similar to those of a diesel rail car—ease of accessibility and maintenance. Here, accessibility and the ease with which maintenance can be performed are figured in terms of 60 tons multiplied by the number of payloads the rig could have made while off the line for service. Now, let's take a look at the power train.

Each engine is connected to a rear axle through separate Twin Disc 3-stage torque converters with 5:1 torque multiplication and down hill braking features. Converters are charged with diesel fuel supplied from the fuel tank which serves as the working medium in transmitting energy to the axle.

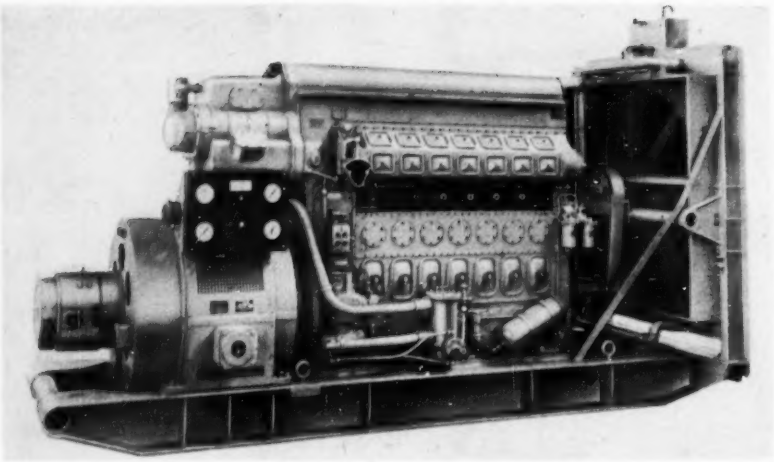
This fluid is circulated through a heat exchanger which in turn cools the converter. Overall reduction of power to the rear axles may be 12:57:1, 15:23:1, or 20:6:1, providing ratios for complete coverage of operating conditions. The tandem rear axles have a capacity of 85,000 lb each and are of the triple reduction, planetary type featuring 5:1 reduction in the planetary wheel.

Hydraulic power for hoisting the body and steering is supplied by two vane-type pumps having a total capacity of 144 gpm at 1000 psi. One hydraulic pump is driven from each engine, thus insuring operation of the hydraulic system should trouble be encountered with one engine. The twin hydraulic hoists are rated at 130,000 lb push and incorporate built-in snubber and pull-down mechanisms. Steering and front end suspension are another departure from the conventional.

A pair of double-acting hydraulic boosters, located on either side of the front axle, provide 56,000 lb of steering effort. In steering, the entire front axle pivots on the single suspension point as did the age-old horse-drawn wagons, allowing axle oscillation over irregular terrain.

The single point front end suspension arrangement incorporates a captive air system similar to that used on the landing wheels of large aircraft. Captive air in the center swivel provides an almost friction-free bearing upon which the whole front axle can turn.

Dart's new dumper will be put to work at the Bagdad copper mines in Bagdad, Arizona where its production and performance will be recorded to guide engineers in the future construction of this type of diesel-powered equipment.



Some design details of the F-M Model 38F5¼ engine. A compact heavy-duty unit for stationary, marine or railroad use.

F-M's Small OP Engine

DEVELOPMENT of the new Model 38F5¼ Fairbanks-Morse engine stems from their original 8⅛-in by 10-in opposed-piston diesel. The larger unit was designed to meet rigid Navy specifications nearly 20 years ago, and met its greatest endurance test as a submarine engine in World War II. The OP was then made available for civilian applications and has gained wide acceptance as a heavy-duty prime mover. Today, there are about 5,000,000 hp in service, including Navy, railroad, civilian marine and stationary installations.

Now, with the new smaller unit in production, F-M is able to offer OPs from 225 hp to 2400 hp. All can be equipped to operate diesel, dual-fuel, or spark ignition gas engines. The new engine can be skid-mounted for portable application or equipped with marine reverse-reduction gears for marine service. Rating is 75 hp per cylinder at 1200 rpm. Bore and stroke are 5¼ in by 7¼ in.

In general, design of the Model 38F5¼ is the same as its larger prototype, having a pair of pistons in each cylinder opposing each other, and with a common combustion space formed by the heads of the pistons. The upper pistons controlling the scavenging air inlet ports are connected to an upper crankshaft, and the lower pistons controlling exhaust ports are connected to a lower crankshaft.

Engines are complete self-contained units with an attached rotary-type blower for supplying scavenging a They are further equipped with attached pumps and auxiliaries as required.

Major Engine Components

Cylinder blocks are the main structural part of the engine. They are fabricated from flame-cut, heavy steel sections and welded into compact, rigid units. After welding, blocks are sandblasted, stress-relieved, and magnaflux-tested to check all vital points. Air receivers and ducts from the blower are an integral part of the block, thus adding to its rigidity.

Guiding lands are accurately machined into the block for precise cylinder liner fitting. Upper and lower crankshaft bearing saddles are also an integral part of the block and are align-bored to assure proper alignment of the crankshaft bearings. Conveniently located openings permit access to all cylinder block compartments.

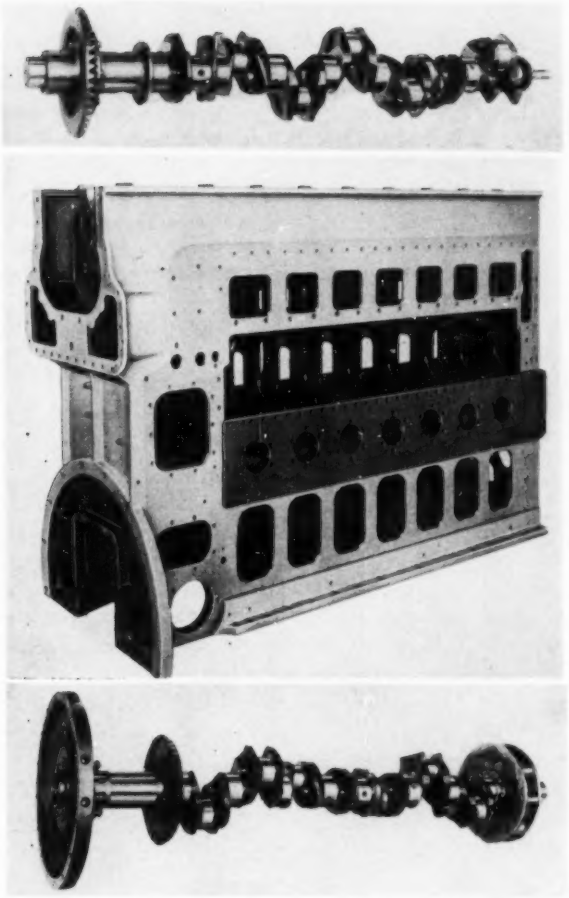
Interchangeable cylinder liners are cast from a close-grained iron of high tensile strength. They are then heat-treated and stress-relieved to insure strength and durability. To provide both adequate cooling and rigidity of structure, liners are fitted with a sturdy steel water jacket around their middle or combustion area. Cooling water flows through fluted passages formed by the liner and fitted water jacket.

The upper part of the liner is cooled by scavenging air while the lower part is cooled by water which circulates through the exhaust manifold housing. Tangential scavenging ports completely surround the upper part of the liner and exhaust ports completely surround the lower part. Cylinders are swept clean of combustion gases by the unrestricted downward flow of scavenging air.

Upper and lower crankshafts act together in transmitting power to the drive end of the lower crankshaft as in the larger OP. This is accomplished by a flexible, vertical drive shaft connected to each crankshaft through helical bevel gears. The vertical shaft turns in large tapered roller bearings with torsional flexibility provided by the flexibe shaft design.

Crankshafts are made from a high-strength cast iron alloy with integral counterweights, and is cored for lightness to minimize main bearing loads. They are further balanced, both statically and dynamically, to obtain vibration-free operation.

Precision bearings, machined from wear-resistant alu-



From top to bottom are the upper shaft, block, and lower shaft. Power is transmitted from the upper shaft to the lower shaft through a vertical shaft (not shown), by means of the helical bevel gears which can be seen above.

minum alloy, were selected for durability. Aluminu crankpin and main bearing inserts are sufficiently large to carry bearing loads exceeding the engine rating To improve crankshaft and bearing alignment, the forged steel main bearing caps are mortised into the engine frame. A large thrust bearing is provided at the drive end of the engine.

When required, torsional dampers are attached to the crankshafts to eliminate the critical speeds of torsional vibration.

Reciprocating Parts

Pistons, as they approach the center of the liner, form the combustion space thus eliminating cylinder heads and minimizing heat losses which would decrease efficiency. The two piston heads form a nearly spherical combustion chamber as they converge midway in each cylinder. Upper and lower pistons are completely interchangeable and are each fitted with three compression and three oil control rings.

A removable piston pin insert rigidly supports the piston pin and strengthens the piston assembly. It also permits a precisely cylindrical and unbroken external surface on the piston.

Piston cooling oil flows through the passages formed by the piston pin insert and the inner piston wall. A hollow, full-floating piston pin is supported by bushings in the piston pin insert and in the connecting rod eye. Drop-forged connecting rods are made from an alloy steel of high tensile strength.

Scavenging System

A positive displacement, rotary lobe-type scavenging air blower is driven through a flexible drive arrangement by the upper chankshaft. When operating the engine at part load, blower output is reduced by an air by-pass valve which reduces excess air and minimizes blower power requirements.

The blower supplies air to the large air receivers on both sides of the engine. In each cylinder, during the power stroke, the lower piston uncovers the exhaust ports before the upper piston uncovers the inlet ports. Thus, most of the exhaust gases escape before scavenging air enters the cylinders. During the compression stroke, the inlet ports remain open after the exhaust ports close. This allows scavenging air to continue entering the cylinders, completely filling them.

Exhaust manifolds, located on each side of the engine, are water-cooled and may be removed from the cylinder block. Ample openings are provided in the manifolds for exhaust port, piston and ring inspection. Thermocouples for indicating individual cylinder exhaust temperatures may be inserted in the manifold covers. A fitting at the forward end of the engine receives exhaust gases from both manifolds and is flanged for piping to the silencer.

Fuel System

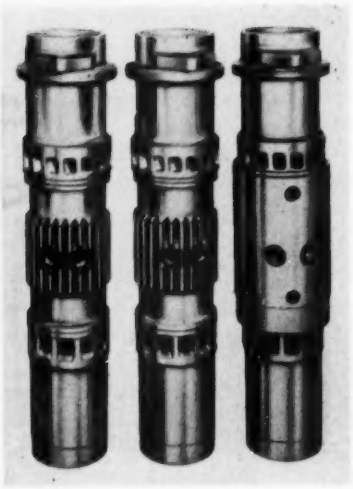
The entire fuel system with the exception of the fuel supply tank is engine-mounted and requires no other attention than an occasional inspection. A positive displacement, rotary gear-type pump supplies fuel oil to the individual injection pumps. Each cylinder receives fuel oil from these injection pumps through a pintle-type nozzle. Injection pumps are operated through a tappet assembly from a camshaft on the control side of the engine.

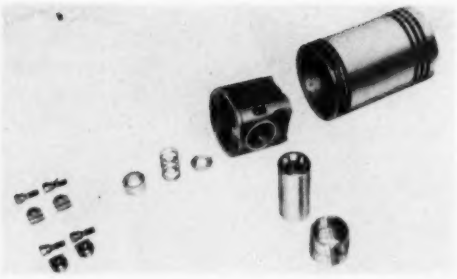
Both injection pumps and nozzles are readily accessible through large openings in the cylinder block. The entire fuel system is adequately protected by the inclusion of strainer filters.

Lube Oil System

A pressure lubrication and piston cooling system supplies a continous flow of oil to all surfaces requiring lubrication and to the pistons for cooling. The engine pressure system consists of a positive pressure gear-type pump, an upper and lower oil header fastened to the cylinder block, and connections to bearings and other points requiring lubrication.

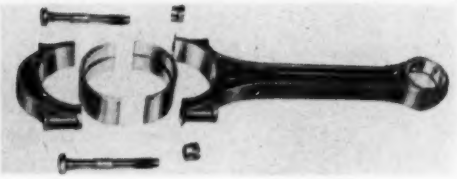
Oil is forced through supply pipes from both the lower and upper headers to each main bearing and through





Here, an exploded view of the piston assembly shows the parts and method of retaining the pin.

At far left, cylinder liners are shown with and without water jacket fitted. Finned construction aids cooling and adds strength around combustion area.



Piston rod assembly for the small OP engine. Rods are drop forged of alloy steel. Bearing inserts are aluminum alloy.

crankshaft passages to each crankpin bearing. From the crankpin bearing, oil passes through a drilled passage in the connecting rod to piston pin bearings and to the piston head for cooling.

The camshaft is lubricated from the upper oil header. Oil flows into and fills the hollow camshaft from a connection at the exhaust end. Small openings at each bearing and cam allow oil to reach the bearing surfaces and tappets. Lubricating oil, draining from the exhaust end of the crankcase, lubricates the timing chain drive arrangement. Oil from special tubing liberally lubricates the blower drive gears and bearings, vertical drive gears, pump drives, and governor drive.

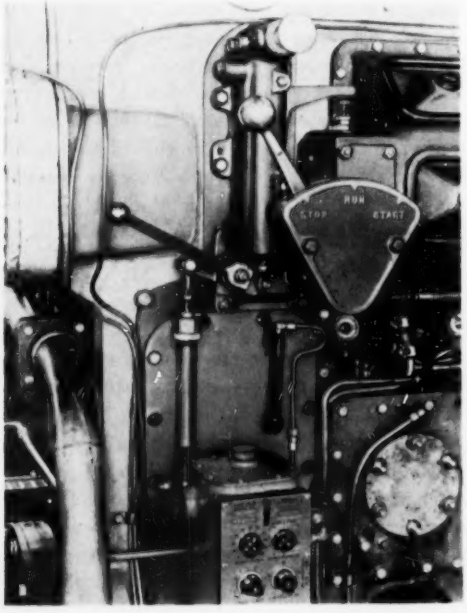
Cooling System

A closed cooling water system is used on the engine. This permits the economic use of fully-treated water. Water enters cylinder block passages closed by the exhaust manifold and circulates around the manifold to the cylinder liner water jacket. From this point, water is piped to an outlet water header where it is returned to the heat exchanger for cooling. A raw water system is used for cooling the jacket water and also to cool the lubricating oil in its heat exchanger.

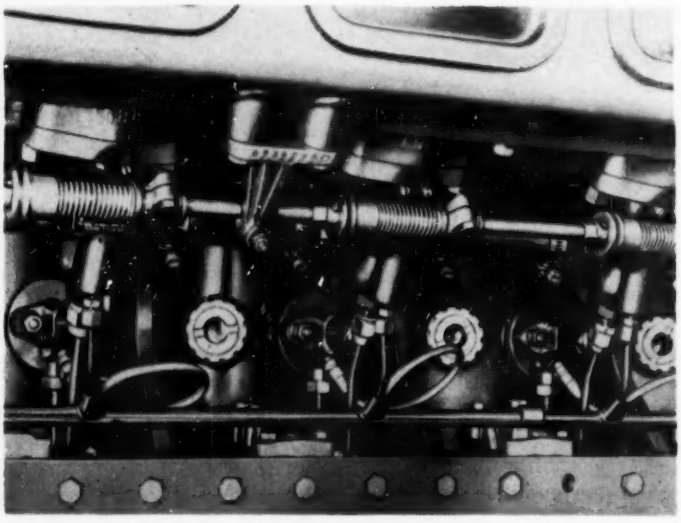
Controls

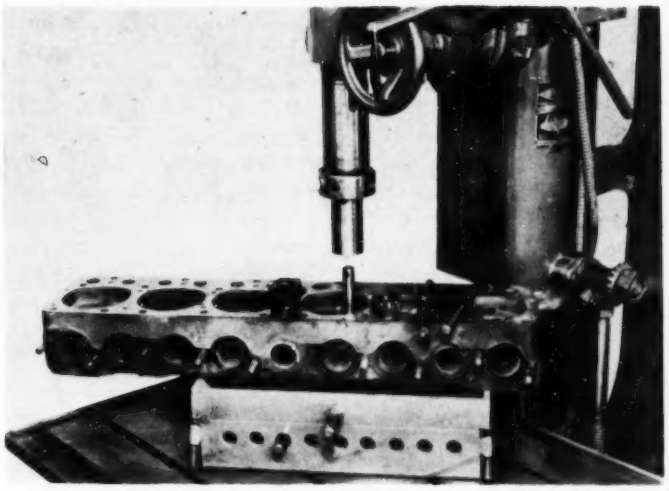
Simple engine controls insure safe, reliable operation. One lever controls the starting, running, and stopping of the engine. In the event of an emergency, the engine may be instantly stopped by pushbutton control. An overspeed governor protects the engine by automatically shutting it down when the maximum safe speed is exceeded.

Before the engine may be started again, controls must be unlocked by moving a reset lever located just to the left of the control quadrant. Engine operation is closely regulated by a hydraulic governor.



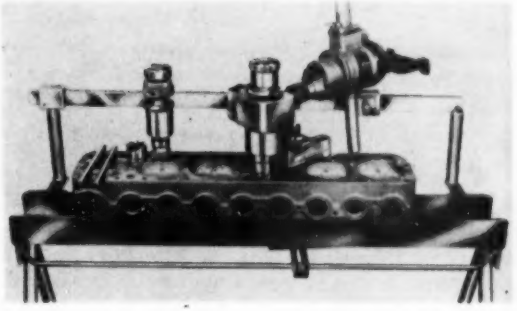
It will be noted from the illustration at left, that one lever controls the starting, running and stopping of the engine. The injection nozzle compartment is shown below. Here, inverted Bosch type APF pumps supply fuel through pintle-type nozzles.





At right, one set-up for installing screw-in valve seat inserts is shown. The operation consists of reaming and threading the counterbore, then screwing in the insert.

Below, a portable stand and hand drill are substituted for a drilling machine. The operation remains the same for either set-up.



An interview with Mr. B. D. Foley, vice president of Peterson Welding Laboratories, Inc., on the subject of their valve inserts.

Screw-In Valve Inserts Can Be Practical

Q. *Mr. Foley, just what are these valve seat inserts that you fellows make?*

A. It's a screw-in type insert of a special material that has some new engineering twists. It avoids some of the more common troubles with the regular interference-fit type, and uncovers a source of valve failure that is usually overlooked.

Q. Whoa! Let's stop there a minute. What are some of the troubles you speak of, in fact, why valve seat inserts at all?

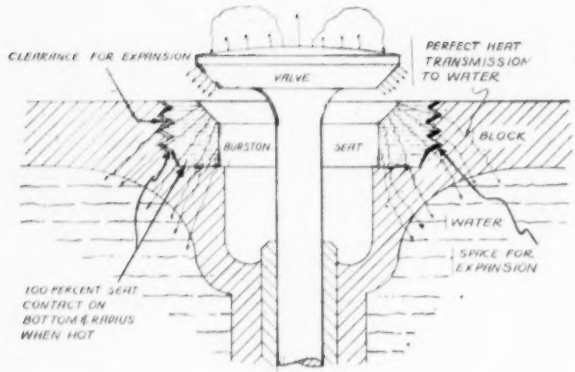
A. Well, valve seats are the only practical method of renewing the valve to its original height, so that the spring tension and other important design features of both valve and valve port can fully be utilized.

Q. All right, how about these other inserts?

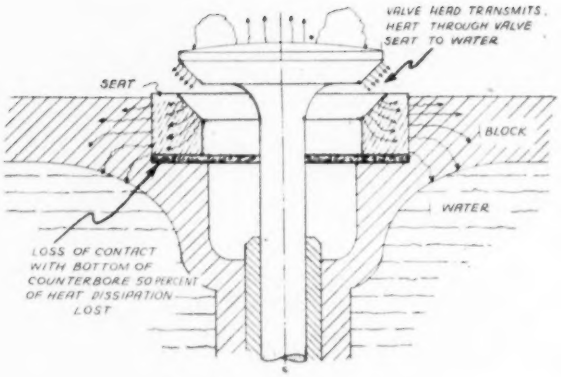
A. Most of the troubles with regular valve inserts come about because of the necessity for interference fits to hold them in place. The big question is, "How much press fit?" No one really knows, engine operating conditions vary, lime and scale conditions vary, and different water jacket thicknesses around the seat cause varied amounts of seat distortion and valve port cracks. Generally, the exhaust seat, being the hottest point in the engine, expands a greater amount than the cast iron of the head. Add this expansion to the usually excessive interference fit used to hold the valve seat in and you will discover the source of seat distortion, valve port cracks and loose valve seats. On some engines where inserts are not used the intake seats distort because the metal on the exhaust side expands more and pushes against the intake seat.

Q. Still, they seem to do pretty well, don't they?

A. Yes, they stay in pretty well, if that is all you want to accomplish, particularly in original equipment, but troubles are more frequently encountered after re-



Screw-in valve seat.


VALVE HEAD TRANSMITS HEAT THROUGH VALVE SEAT TO WATER
SEAT
BLOCK
WATER
LOSS OF CONTACT WITH BOTTOM OF COUNTERBORE 50 PERCENT OF HEAT DISSIPATION LOST

Typical pressed-in valve seat.

placement. The point so often missed is that there are a lot of troubles that come up—from head cracking to seat distortion and premature valve failure—that are considered normal to valve service and are not attributed to the necessity for interference fits on inserts.

Q. Is all this avoided with the screw-in type insert?

A. Depends on the insert; the idea is now new, you know. The old threaded inserts were so tightly fitted in the threads that it took real force to screw them in. In such cases, the problems, except falling out, were about the same.

Q. Why do you say that more trouble is encountered with replacement inserts?

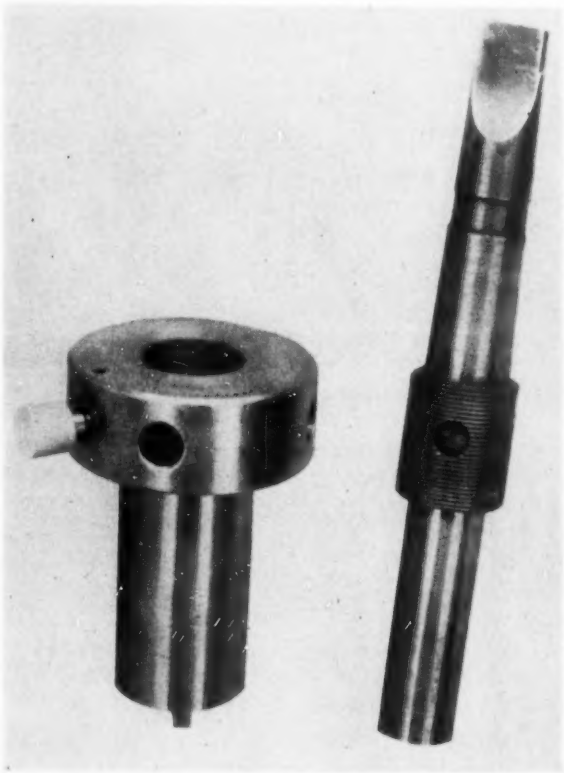
A. The big trouble is that replacement is rarely done under the controlled conditions of original manufacture. Engine builders have it down to a science and have all the equipment necessary. In the field, it's rougher. First the proper dimensions are not always known or observed. Where factory interference fits may be 0.003-0.004 in, a press fit in the field willl generally be much higher, say 0.006-0.008 in, to account for inaccuracies and to be on the safe side. Then comes the problem of shrinking the insert so that the insert can be installed with a minimum of pressure.

Frequently when the necessary equipment is lacking, excessive pressure is used and the insert actually broaches metal off the counterbore. Naturally, it can't seat properly and some of the interference fit is lost. Or again, the insert may be cocked when it is pressed into place.

Aside from the possibility of falling out, with all the damage than can occur, there is the problem of poor heat transfer. You realize, of course, that about 75 per cent of the heat of the valve head must be dissipated through the seat, the head material, and cooling water. Most of the transfer is through the side since the bottoms of the seat inserts are rarely in full contact with the bottom of the counterbore. (It's no wonder then that we have so much premature valve burning.)

Q. Well, how do you overcome the problems with your insert?

A. In the first place, the material used is specially compounded to have the necessary functional qualities. Then, since the insert is threaded into the head or block, there is no question of interference fits. The threading tool that cuts the threads in the counterbore is a precision machine, so that they are cut accurately and their axis coincides with that of the valve stem. Then the insert is made accurately so that the threads and the bore are concentric. Thus, there is no problem of shrinking or heating, no pressure is required, and there is no chance of cocking.



A close-up of the special wrench and tapered adapter for drill press shows lead screw arrangement for tapping counterbore. During reaming, the two pieces are locked together by the set screw.

Q. Wait a minute. You just got through talking about heat transfer. If the insert is tight enough to give close thread contact to conduct the heat away, it will take force to thread it in, and as long as there is a difference in the amount of expansion, there is a possibility of distortion?

A. No, that's where the new engineering features come in. The threads are specially formed. They are made so that there is clearance between the crown of the insert thread and the root of the counterbore thread. The fit is actually fairly loose and the insert screws in easily. When the insert seats on the shoulder at the bottom of the counterbore, any further torque forces the insert against the bottom of the counterbore and the upper face of the insert threads into close contact with the lower faces of the counterbore threads. Any expansion due to temperature only increases the pressure at these contact points, because the clearance between the root and crown of the threads permits relative motion along the thread contact faces; no appreciable radial stresses are imposed. (In salvage jobs, cracked heads or blocks are repaired and the seat inserted with absolute lack of force, eliminating the possibility of reopening the cracks or causing fresh ones.)

Q. What about the heat transfer; there is clearance between the other faces of the threads?

A. If you figure total contact area of the mating threads plus the positive contact at the bottom of the counterbore, you will find that it exceeds that of the conventional insert, particularly in view of the fact that the lower faces of the press-fit inserts rarely make full contact. Incidentally, the positive bearing of the threaded insert on the bottom of the counterbore prevents any leakage of combustion gases behind the insert.

Q. Roughly what is the method of installation?

A. First, the special tool is used to recut the counterbore and face the bottom. Next, without changing the set up, counterbore is threaded with a precision ground tap using a lead screw to feed it down. Now the insert is screwed into place. The upper end of the insert has two notches for a simple key wrench that is used to tighten it into place. Only moderate pressure is required. Of course, the insert is thicker than the counterbore is deep, so that when seated it extends beyond the face of the head. This excess is machined off, and the seat angle is then finished by normal seat grinding. Replacement can be done by chipping a piece out of the seat to remove it. Clean the old threads and screw in a new insert. No oversize is necessary.

Q. Are these threaded inserts only for replacement use?

A. Not by any means. They are equally adaptable for replacement or original equipment use. Special drill press installing tools are available for production work.

Q. How do the economics compare with this type seat insert and usual variety?

A. Pretty well, as a matter of fact. Once the necessary tooling is on hand there is not much difference in the cost of the two types of seats. Any slight increase in seat cost is easily offset by a reduction in engine downtime and the resultant loss in revenue. The big thing, as far as we are concerned, is that you get a better job. For example, the lack of distortion in the insert reduces the amount of valve burning. Remember, you can't seat a round valve on a distorted seat. The seat is always accurately centered although it has room to breathe. Its design permits it to expand without encurring distortion or radial stressing the head material. We know that this will pay off in longer trouble free valve performance and avoid a lot of head and block cracks. These are things that you must consider when you assess the cost of a valve insert job.

What Do You Know!

Some questions selected to test your knowledge of different aspects of the diesel field. After you have made your selection of answers, turn to Page 66 to check for correctness.

1. Diesel fuel is ———— used as the working media in torque converters for vehicular application. Select the correct word from those below.

   a. Never b. Sometimes c. Always

2. A good proportion of the heat in an engine valve must be dissipated through the valve seat. For a good average figure, which of the following percentages would you pick?

   a. 50 per cent c. 75 per cent
   b. 60 per cent d. 90 per cent

3. After valve seat inserts are reground a few times, it is necessary to replace the insert because—

   a. the seat is too wide
   b. the valve must be brought back to original height
   c. it is too soft

4. Impact wrenches will do a good job of tightening bolts and nuts. One trouble is that it takes a good man to buck them when the going gets tough.

   a. True b. False

5. The purpose of spectrographic analysis of used lubricating oil is to—

   a. check its suitability for further use
   b. check on engine condition
   c. check the amount of carbonaceous material in it

6. The principle of spectrography, briefly, is that when radiant energy from an incandescent object is passed through a dispersing medium and then brought to a focus, an image called a spectrum is produced. Each element produces a characteristic spectrum and can be identified.

   a. True b. False

7. The spectrograph as applied to railroad service is used as which of the following?

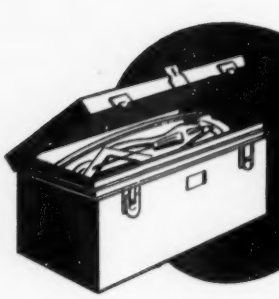
   a. a tool for laboratory analysis
   b. an evaluation tool for testing lube oil
   c. a maintenance tool

8. Because diesels are sometimes hard to start in sub-zero temperatures, it is not practical to adapt them for fully-automatic operation when such conditions are encountered.

   a. True b. False

9. Parallel light and heavy fuel systems are necessary when burning heavy fuel to—

   a. provide against failure of heavy fuel supply
   b. utilize higher cetane of light fuel when starting
   c. Purge viscous heavy fuel from pumps before stopping



Straight from the Tool Box

This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

Tightening Down Valve Cages

FREDERICK G. HEHR, SANTA MONICA, CALIFORNIA—On several large 4-cycle engines we had constant trouble with warped and broken exhaust valves and their cages. After studying the problem for some time, I decided that it was not a design fault but that the damage was being done at the time of installation. The four nuts holding down the cages were being pulled up tight and I suspected that the strains, sometimes uneven, were distorting the seats even before the engine was started.

Once the seat was distorted, the hot gases started to leak by the seat, and frequently the valves were warped and burned and the cages warped and cracked in as little as three days. It did no good to tell the men not to tighten them down too much or to specify tensions. Finally, I worked out a practical solution.

We made wrenches of ⅛-in sheet metal and only provided a 3-in handle. With these it was impossible to apply too much torque, not only because of the short handle but because the wrench jaws would tear out. These were to be used on all cage nuts.

After this procedure went into effect the valves worked for months before service was necessary. Servicing then consisted of light lapping to restore the seats, whereas before we had to straighten the valves and then turn them in a lathe. Expansion of the cages from working heat seated the cages just nicely, giving an ample seal. Without the strains of high original tension, plus the expansion, the seats were not distorted. Gases could not blow by, and the entire seat helped to transfer heat away from the valve head.

A good tip to keep in mind and one that has many parallel applications. Too much tension can be as harmful as too little. Overtightening of connecting rod bearing bolts can distort the bore and the bearings. Jamming an injector against the sealing gasket by overtightening will certainly stress the head and may distort the injector and cause a bind.

We once encountered this on a large scale with respect to hold-down crabs on GM 6-71 injectors. This was licked by specifying that the hold-down nut be threaded on, finger-tight. Then a wrench was used to give it a quarter turn. Unless leakage was found, it was to be left alone, otherwise give it another eighth turn. Rarely was this required. We had less injector trouble and fewer cracked heads thereafter—Editor.

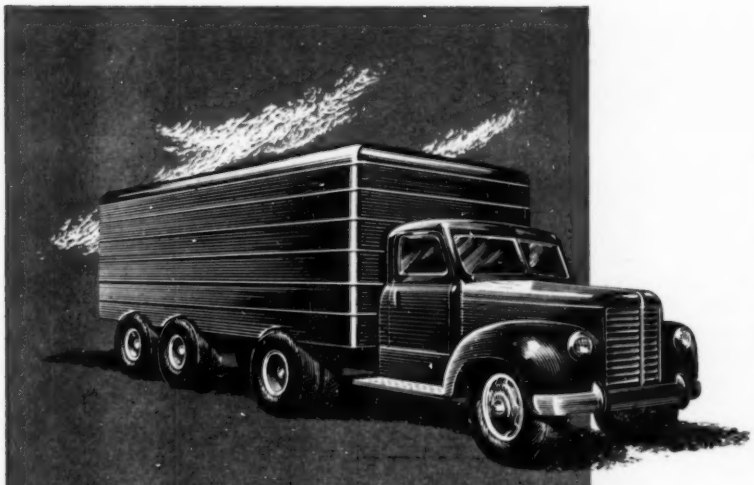
More on Hard-to-Place Gaskets

OLE CHRISTIANSEN, KINGSTON, NEW YORK—Have been a reader of your magazine for years and find it interesting and helpful. I like the "Straight from the Tool Box" department where I read the tip from Australia on using cellophane tape to hold hard-to-place gaskets in place. I would like to pass along a very helpful suggestion about the same thing.

Coat the surface of the gasket and also the surface for which the gasket is intended with rubber or tire-patching cement. Allow it to dry for 15 minutes or so. Then put the gasket in place—and I mean the right place—because when the dried surfaces are placed together, they are there to stay. It is a good deal for cork gaskets since you can stretch them to fit and the cement will hold them in place.

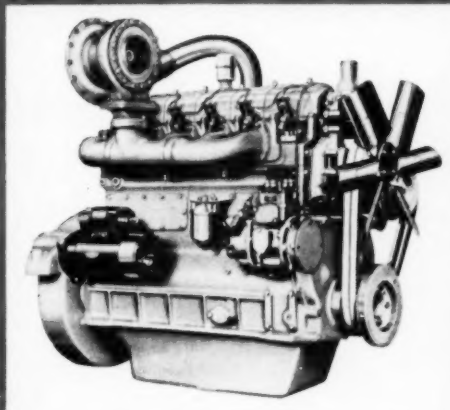
That's it; try it and you will never have to worry about the gasket slipping out of place. I hope that this little suggestion will be of as much help to others as it has been to me.

Gaskets and gasket troubles are always around to plague the man working on the engine. Check the number used on the average engine, and most of them are different both in shape and material. Some are a particular headache. We know of a gasket used to seal a crankcase door, on a big engine, against oil leakage. It was of strip cork and due to its size was made in sections. The end-seals had to go through three or four designs before one that sealed was found. Apparently, even manufacturers have troubles with gaskets—Editor



FAST SMOOTH POWERFUL

WAUKESHA 135 Series



135-DKBS—TURBOCHARGED DIESEL
Maximum hp 185 @ 2800 rpm.

426 and 451 cu. in. Diesel or Gasoline ENGINES 147 to 185 max. hp

212

• Versatile and rugged — Waukesha Model 135 Engines are ideal for almost any transport service in their speed and power range. The gasoline versions are 426 and 451 cubic inch displacement, with updraft or downdraft carburetion. The 135 Diesels are 426 cubic inch, either normal or turbocharged. Counterbalanced crankshafts, aluminum pistons, full pressure oiling—every modern feature! Exceptionally rugged, but smooth and lively, with no unnecessary weight. For medium speed and industrial service these engines are available with standard crankshafts. Send for bulletins.

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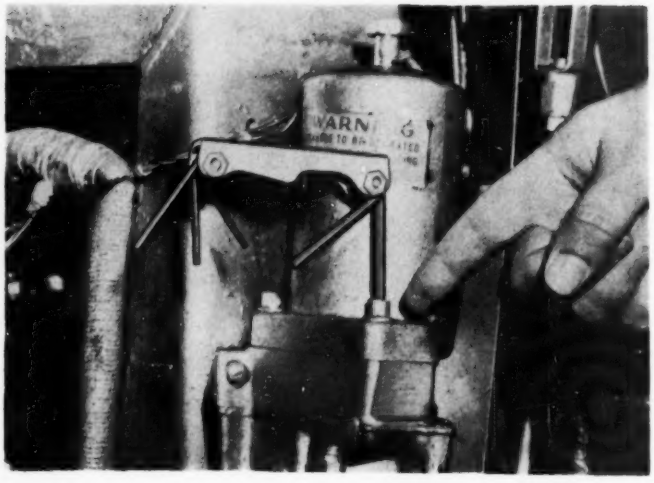
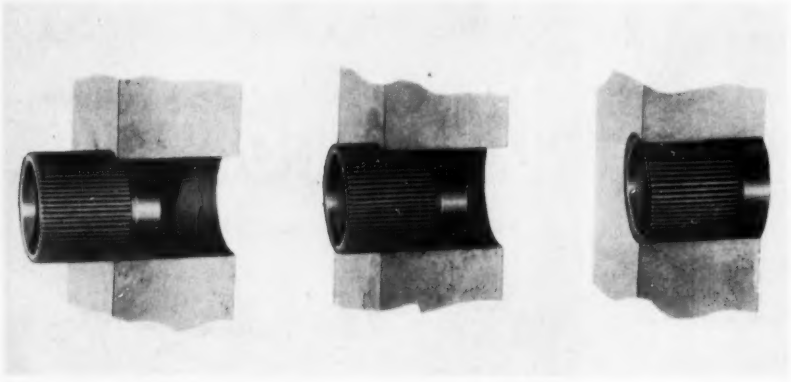
Allen Wrenches



A new twist was given to the Allen wrench, by the H. D. Hunter Tool Co. of Whittier, California, when a set of five wrenches was combined with a sturdy knife-like folding handle, small enough to fit into a pocket. Design of the Smitty, as it is called, permits greater leverage at almost any angle.

Five sizes of shaft individually swing out of the knife-like holder into driving position. To cover the range of Allen head bolts and screws, two models are currently being produced. Model P-5 fits No. 10 to 7/16-in set screws and No. 5 to 5/16-in cap screws inclusive. Model P-6 handles wrenching of set screws from No. 3 to 5/16-in and cap screws ranging from No. 1 to 12 inclusive. The Smitty will probably save much of the time that is lost in looking for the right size Allen wrench.



Broach-Fit Bushings

Bushings that actually cut their way into cast metal, plastic and steel have been introduced by the Aeroquip Corp. of Jackson, Michigan.

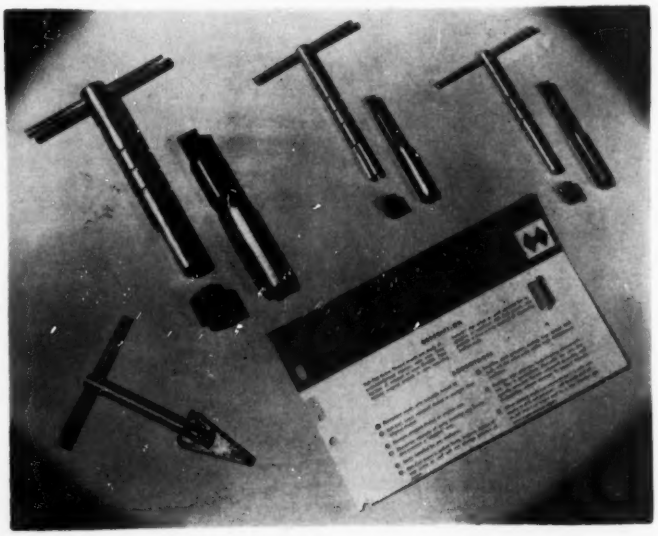
Installation of the new bushing is shown from left to right as follows: pilot slips-fits into standard hole, to provide an accurate lead and prevent cocking; as bushing is pressed into place, the broach cuts its way into hole wall; when completely inserted, bushing is securely locked in place.

Thread Repair Kit

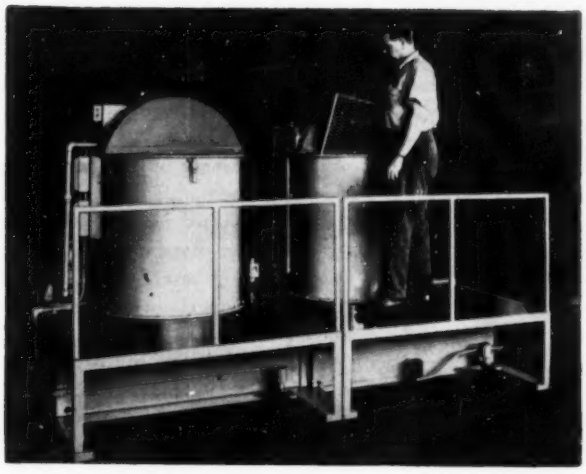
A wire thread insert kit for the repair of worn and damaged threads is now available from the Heli-Coil Corporation of Danbury, Conn. Each kit consists of three special taps, three inserting tools, one extracting tool and 25 stainless-steel Heli-Coil wire thread inserts in three different thread sizes.

Insert sizes, corresponding taps and inserting tools, available in standard kits are for those thread sizes most commonly found in the assembly of internal combustion engines. In addition, a wide variety of other insert sizes is available.

Thread repair with this kit requires only: cleaning out the original hole; tapping the cleaned hole with a Heli-Coil tap; and screwing the wire thread insert into the hole with the inserting tool. This equipment was designed to permit fast and economical thread repair in all types of metals.



PREVIEW



Filter Washing and Oiling Machines

Mechanical application of the new semi-fluid air filter coatings has been simplified, according to the Paxton-Mitchell Company of Omaha, Nebraska, by a new design. The new machines are designed to operate as companion units.

One machine is a washing machine which functions somewhat like an automatic clothes washer. The other is the oiler, which operates on an automatic cycle, applying the coating material at a controlled temperature in the correct amount recommended for greatest filtering efficiency.

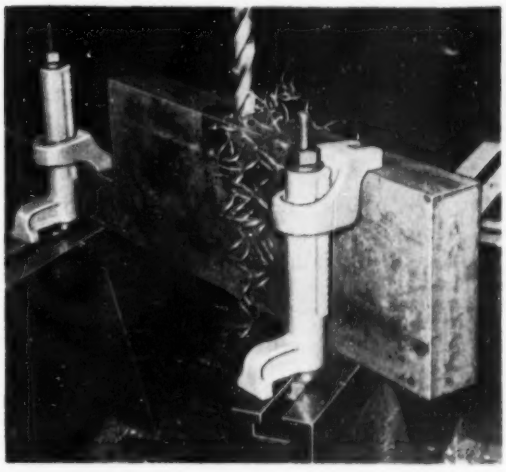
The washer cleaning cycle is manually controlled, thus allowing the necessary latitude for the degree of washing required to get filters thoroughly clean. Additional information is available from P-M's Dept. A 14.

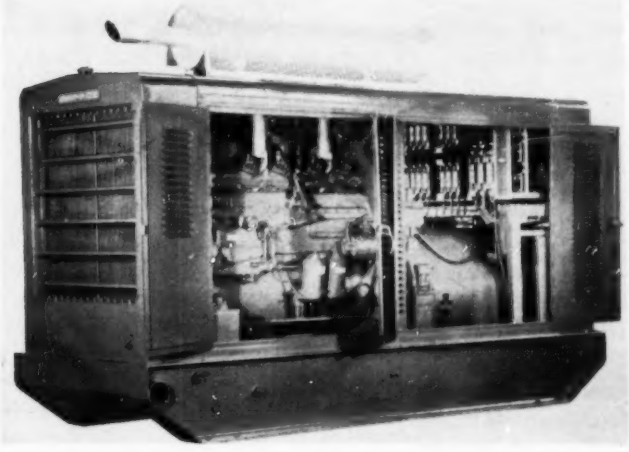
Wide Range Clamp

A recent development of the Clamp-All Company takes the form of a simple device for quickly and securely clamping large or small work on radial drilling machines and other machine tools having T-slot beds.

According to Clamp-All, the new clamp will eliminate the need for many make-shift holding gimmicks, and has been designed to provide simple adjustment and locking features, reducing set-up time.

The clamp consists of a hardened T-slot bolt and flange nut, a cast clamp post, and two interchangeable cast clamping arms. One arm is designed for clamping to within $\frac{1}{4}$ in of the machine bed while the other arm is designed for high clamping, up to 11 in. Further information may be obtained by writing the Clamp-All Company, 895 Montford Road, Cleveland 21, Ohio.





Power Unit for Welders

A 100-kw packaged engine-generator unit, designed to reduce costs and increase working efficiency of large-scale arc welding operations in the field, was recently introduced by The Ready-Power Company of Detroit, Michigan.

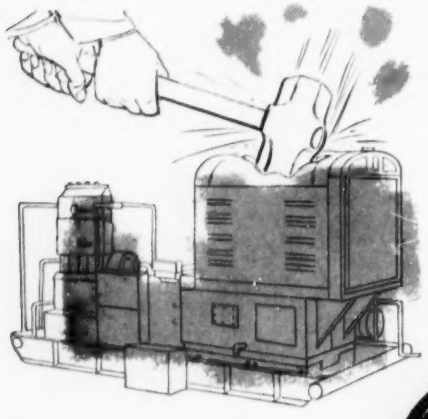
The new unit provides for simultaneous operation of a bank of seven welding machines, and can also power a 50-hp electric air compressor plus a drop-cord line for the operation of power tools and emergency lighting. Power for the unit is provided by an International Harvester diesel engine. The unit, fully equipped with protective controls, is completely enclosed in a weather-proof housing. Its structural steel base has high ground clearance and wide skid for maximum mobility and flotation over rough or soft terrain.

New Soldering Flux Test Kit

Division Lead Co., 7742 W. 61 Pl., Summit, Ill., announces availability of a new soldering flux test kit to replace the former smaller kit. Included in this new kit are double the test quantities of fluxes, thinners, residue removers, and chemical wire strippers, together with a flux chart which describes and rates each flux and all other facts important to attaining the answer to any soldering problem. Guesswork is said to be eliminated.

Plastic Glove Reconditioning

U. S. Industrial Glover Corp., 9350 Roselawn, Detroit 4, Mich., announces a new service to industry, the reconditioning and reprocessing of worn and damaged, smooth and rough plastic dipped cotton gloves. The service includes cleaning, sterilizing, patching and repairing, reshaping, recoating, vulcanizing, and pairing "which assures in most cases 100 per cent reusability" at a fraction of the cost of new gloves.



IT CAN HAPPEN to your engine!

No one will swing a sledge hammer on your engine *but* here's something just as destructive. Oil pressure failure or overheated cooling water can develop even in the best engine . . . and create serious damage and costly repairs!

That's why *your* engines should be protected by PENN Safety Controls. Then, if water temperature becomes overheated . . . or if oil pressure falls too low . . . the PENN control goes into action! Automatically, it sounds an alarm, flashes a warning light or stops engine operation . . . whichever you choose. The minor trouble then can be investigated and corrected before serious damage develops.

Learn more about this *low-cost* protection for *new and old engines.* Write **Penn Controls, Inc., Goshen, Ind.** Export Division: 13 E. 40th Street, New York 16, N. Y., U.S.A. In Canada: Penn Controls Limited, Toronto, Ontario.

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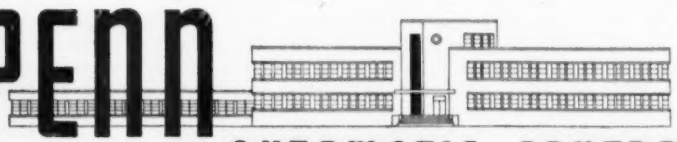


AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, GAS APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

Hose Fitting Development

Aeroquip Corp., Jackson, Mich., announces production of a new type of hose fitting called the "Little Gem", which introduces a different principle of sealing the fluid inside the hose. In contrast to hose fittings generally used which clamp the hose end between nipple and socket to accomplish a fluid-tight seal through compression, the design of the new fitting is such that the reinforcing braid of the hose alone is clamped while the fluid type seal is accomplished by separating the inner tube from the braid and using it as a lip seal in an annular chamber.

Main advantage claimed for this new development lies in the reduction of compression of the rubber or rubber-like inner tube. These materials, as well as certain plastics, tend to take on a definite set and flow away from the zone of compression under extreme compression. This action is accelerated by heat. As a result, compression type hose fittings have a limited service life dependent upon the temperatures encountered.

Electro-Hydraulic Tester

Thwing-Albert Instrument Co., Penn St., Philadelphia 44, Pa., announces a new electro-hydraulic tensile tester with a rigid crosshead and using strain gauges for load measurement.

The hydraulic drive system provides constant rates of elongation adjustable on a throttle dial with no gear changing required. The system is claimed to have low inertia and to perform at high speeds without overshoot. Full scale load ranges from 5 g to 5000 lb. A larger model is available for ranges up to 10,000 lb. The electronic recorder and controls come in a separate cabinet that can be moved without respect to the tester.

Quick-Release Valve

A quick-release valve guaranteed not to chatter has been announced by the Deublin Co., Glenview, Ind. Designed to handle air pressure from 0 to 250 psi on pneumatic clutches up to 1500 hp, the valve features light weight, a built in orifice, double-piston design, and elimination of need for a spring.

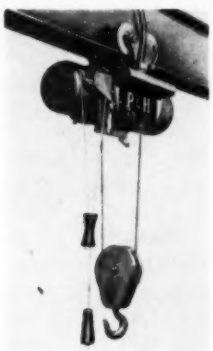
Tubeless Truck Tire

A tubeless truck tire mounted on a one-piece, drop-center rim has been developed by the Firestone Tire and Rubber Co., 1200 Firestone Pkwy., Akron 17, Ohio. The development is said to make changing of truck tires as simple as the mounting and demounting of passenger car tires.

A departure from conventional truck tire design is the new bead construction. A conventional tire is held on the rim by flanges of substantial height. The new tire is supported on the rim by a tapered fit so that the high flanges are no longer necessary. Lowering of the rim flange permits the tire to be mounted on a one-piece, drop-center rim. The forced taper permits a lighter construction and a substantially lighter rim is made possible.

Low-Priced Electric Hoist

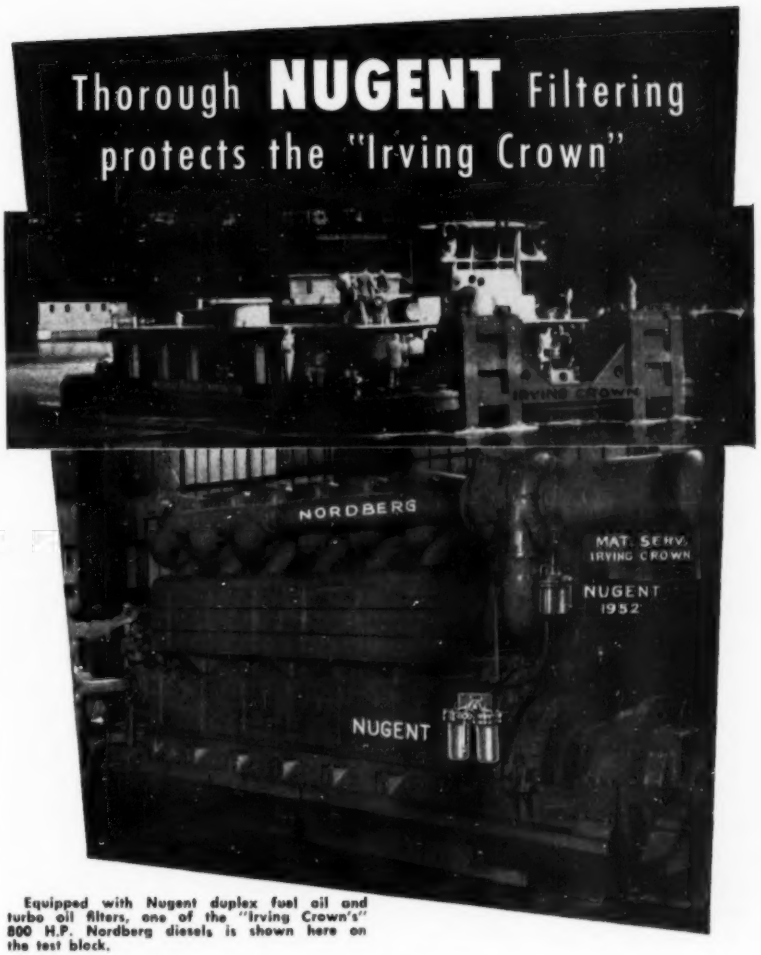
A new model Zip-Lift electric hoist with rope control, having all the features of the regular model at a reduced price, is announced by the Harnischfeger Corp., 4400 W. National Ave., Milwaukee 46, Wis.



The company stresses that the hoist is guaranteed to operate continuously during intermittent usage for a 25 per cent longer period than the rated time limit. Weight-overload safety factor is also said to be five times rated capacity.

Wire rope hoisting is used because of wider range of side pull and safety from hidden wear. Double brakes, oil bath lubrication, fully-enclosed construction, and greased-packed motor bearings are other features. The hoist comes in two models with lifting capacities of 500 and 1000 lb. Rates are 25 and 13 fpm and are available with 12-ft and 18-ft lift.

Thorough **NUGENT** Filtering protects the "Irving Crown"



Equipped with Nugent duplex fuel oil and turbo oil filters, one of the "Irving Crown's" 800 H.P. Nordberg diesels is shown here on the test block.

TWO COMPLETE NUGENT filtering systems were factory installed to protect the twin, 800 H.P. Nordberg diesels that power the new tow boat, "Irving Crown".

To assure the Nordberg of an absolutely clean fuel oil supply and trouble-free combustion, each engine is equipped with a Nugent Duplex Fuel Oil Filter. To protect vital turbocharger bearings from the damage of dirty oil, a Nugent Duplex Filter was installed on the turbocharger lube line of each engine. Thorough Nugent fuel and turbo lube oil filtering of this type helps assure the "Irving Crown" of dependable engine performance for years to come.

Nugent Duplex fuel and turbo lube oil filters of the above type were factory installed on the 4-cycle Nordberg diesels that power the tow boat "Irving Crown".

For long, trouble-free engine service, Nugent filtering is a must. Offering more effective filtering at lower cost, Nugent filters are available in a complete range of sizes and types to meet every filtering need. *Write for full data, outlining your filtering requirements.*

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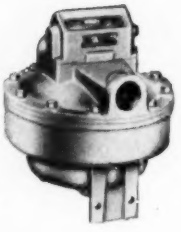
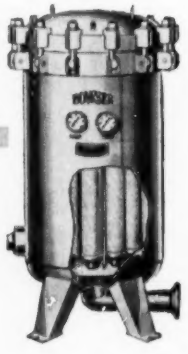
Bowser is the pioneer and foremost builder of fuel-handling equipment. Whether it is a single dispensing pump or a complete high-speed fueling system, Bowser can supply the exact equipment to meet your needs and will assume full responsibility to assure you complete satisfaction.



metering

The heart of your "cost control" should be a Bowser XACTO meter. These "sealer approved" meters will accurately check fuel oil receipts, record dispensing and provide consumption data on all units.



filtering

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Direct-Drive Angle Grinder

Ingersoll-Rand Co., 11 Broadway, N. Y. 4, N. Y., is introducing a new air-powered, direct-driven angle grinder, said to eliminate the need of bevel gears, or gears of any kind. Speed of the new size 2FA-60 angle grinder at 90 psi air pressure is 6000 rpm.

Two types of dead handles are available, one straight and the other 30 deg off straight. The handles may be attached to either side of grinder and the angle dead handle rotated to any one of four positions, making the tool adaptable for corner grinding or for right or left handed operators.

Trouble-free service is provided by a built-in lubricator; the motor is muffled for noise reduction, and the exhaust deflector is adjustable to deflect exhaust away from operator. Throttle is quick-acting and heavy-duty ball bearing construction reduces friction.

Electrical Metal Developed

Battelle Memorial Institute of Columbus, Ohio announces development of a low-cost aluminum-antimony compound for use in many electrical gadgets. Dr. A. E. Middleton of the private research laboratory said that rectifiers of the new material already have been produced.

Institute research, he said, shows that aluminum-antimony can act as an electrical switch under exposure to light and that it can be used to convert light to electrical energy. This may make it useful in photo-electric cells, number counting devices, etc.

The new compound combines the properties of a conductor like copper and an insulator like glass, which means a built-in ability to convert AC into DC in a rectifier or to detect, transmit, and amplify wireless electric signals in a transistor. It is said that

the compound might be a possible competitor of germanium and silicon materials.

Silicone For Weld-Improving

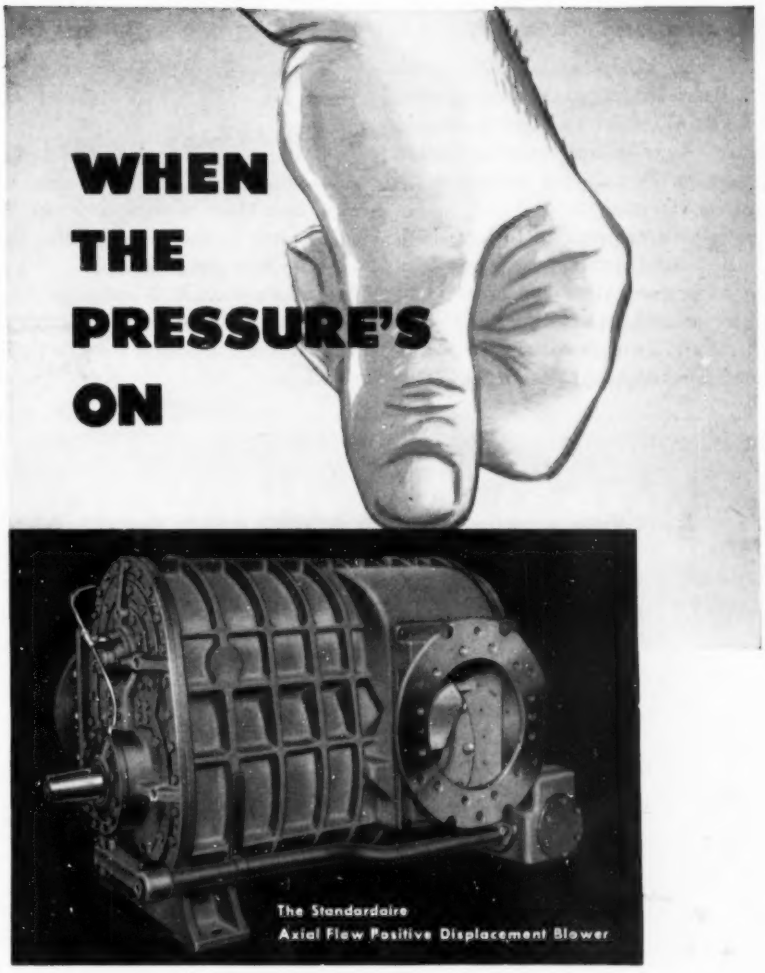
Silicone material is being thinned to a fluid paste and marketed as a weld-backing compound by the General Electric Co.'s welding department at Fitchburg, Mass. Painted on joints before welding, the product is said to promote uniform weld penetration and to eliminate harmful effects of air on the underside of welds. It is suggested for use in all arc welding processes except automatic inert-arc welding where argon is used as the shielding gas.

The company says the new compound overcomes many of the disadvantages of fluxes, metal and gas backing media. It is easily applied to complex parts and the powder residue left after welding can be removed with a cloth. Because it promotes no carbon pickup in the weld, it is said to be useful in the welding of low-carbon stainless steels. No noxious fumes are said to be given off by the compound and it is non-explosive.

One-Man Digger

A lightweight, portable one-man digger has been developed by Eugene John Freeman & Co., P. O. Box 2143, Van Nuys, Cal. Hole-A-Minit Model 63 S is claimed to dig 6-in holes, 3-ft deep in just one minute, while Model 636 S digs 6-ft deep and with a shaft extension digs beyond that depth.

The diggers operate with any air drill equipped with standard Jacobs chuck or may be used with ½-in or larger electric drills rated at 500 rpm or less, 7 amp or more. Tool is said to be rust-proof and will work in remote locations from a 1½-kw portable AC or DC generator.



for increased air handling efficiency . . .

Consider a Standardaire Axial Flow Positive Displacement Blower *first*. Its unusual design features provide the greatest output per pound of weight ever achieved in this type of blower.

The Standardaire Blower employs an exclusive means of compression which provides a wide range of pressures with a minimum of internal losses. It can be operated at high speeds, permitting direct drive by favorably priced, standard motors in an efficient speed range.

Air is drawn in and discharged smoothly. Compression is gradual and free from the shocks which load internal parts and decrease efficiency.

These are but a few of the unique features of this compact unit which assure outstanding results. For further information, write . . .

CORPORATION

Vibration Isolation Pads

Hobsite Products Co., 308 Sussex St., Harrison, N. J., is starting production on vibration isolation pads said to save wear on machinery and other equipment by reducing noise and absorbing vibration.

The pads are claimed to have both elasticity and damping characteristics in proper proportion and are said to be impervious to diesel fuel and other oils. They are easy to install and the usual loading weight is 6 psi. They are available in 36-in sq sheets, ¼-, ⅜-, and ½-in thick, or can be cut to specifications.

Truck Fuel Tanks

New models of diesel and gasoline truck fuel tanks averaging up to 50 lb less weight are in production by the Lintern Corp., Painesville, Ohio. The tanks are ready to be shipped 24 hours after order is received, it is announced. Capacity ranges are from 30 to 145 gal.

When you buy an engine

take a good look at the gears

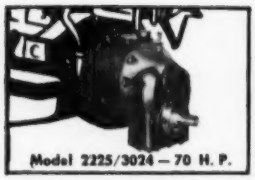
be sure they are **S-N**

REDUCTION GEARS

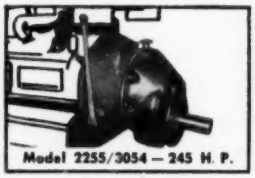
They Ease You Through the Tough Ones

You'll find the world famous S-N heavy duty herringbone Reduction Gears wherever heavy duty equipment is on a continuous, grueling assignment. They are ruggedly designed for efficient, around-the-clock operation with all types of engines from 40 H.P. units right on up to the 775 H.P. giants! This means heavy duty equipment like cranes, pumps, locomotives, shovels, generators, draglines, compressors and all types of dredging and ditching equipment.

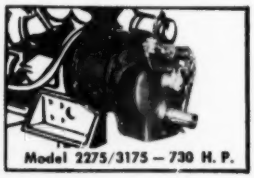
S-N herringbone Reduction Gears are especially designed to transmit full power from engine to load smoothly — at the most economical speed for the driven equipment. Rugged—compact—and versatile—S-N heavy duty herringbone Reduction Gears deliver more power per gallon of fuel than any other method of speed reduction. Standard ratios available in 1.5:1, 2:1, 2.5:1, and 3:1 in both anti-engine and engine rotation. Special ratios available in some models up to 4.7:1. S-N engineers will gladly assist you in specifying the best unit for maximum performance on your equipment.



Model 2225/3024 — 70 H. P.



Model 2255/3054 — 245 H. P.



Model 2275/3175 — 730 H. P.

SNOW-NABSTEDT

Transmission Engineers

FOR NEARLY HALF A CENTURY

INDUSTRIAL DIVISION

THE SNOW-NABSTEDT GEAR CORP., HAMDEN, CONN.

Plastic Screw Anchors

Two new plastic anchors designed for use with ⅜-, 7/16-, and ½-in lag screws, or corresponding wood screws, have been announced by Holub Industries, Inc., Sycamore, Ill. The anchors are made of ethyl cellulose and have a holding power of 2 tons in concrete.

Design of the anchors provides two separate sections, one to receive the screw and the other to engage the wall of the drilled hole. As the screw is turned in, the anchor expands and the plastic material cold flows into the crevices, bonding and fusing automatically.

Automatic Pick-Up Tweezer

Win Sales Co., P.O. Box 257, Forest Hills, N. Y., is introducing a stainless steel tweezer designed so that it can easily pick up oddly shaped objects that are difficult to grasp, and can get into spaces too small for the hand to reach and hold or adjust parts.

Depressing the top plunger causes three hooked steel fingers to extend from the tip and flare out. Releasing the plunger causes the fingers to withdraw to the tip and close. The fingers extend out to approximately 1¼ in between tips.

New Ground Clamp

Tweco Products Co., Box 666, Wichita, Kan., announces a new low-priced ground clamp, model GC-200 which has a rated capacity of 200 amp. It features a protruding upper lip for extra leverage, wide jaws for added conductivity, serrated lower jaw to remove rust and scale as clamp is applied, and a fully insulated spring.

New Literature

Lubrication for Earth Moving And Construction Machinery

Cities Service Oil Co., 70 Pine St., New York, N. Y., has issued a 57-page booklet on the lubrication of earth moving and construction machinery.

Beginning with an explanation of friction and necessity for lubrication, the booklet continues with descriptions of various classifications of greases. Machine elements requiring lubrication are next discussed, with a separate treatment devoted to the various parts that make up the completed machines, so written as to enable the reader to trace their relationship to the machines.

Advantages of diesel engines are detailed and problems of engine deposits, etc., are discussed in relation to lubrication selection. Oiling systems of air compressors, pneumatic tools, pumps, and rock crushers are lastly considered, and a 4-page lubrication chart, including parts and units, completes the book.

Technical Service Report

Copies of *Technical Report, New Series—Vol.* 1, have been received by the Royal-Liverpool Insurance Group, 150 William St., New York 38, N. Y., from the British Engine Boiler and Electrical Insurance, Co., Ltd., England, for distribution to interested persons in this country. The aim of this 212-page book is to disseminate experience acquired by the company in the course of its work as an inspecting organization.

Covered in the broad range of the book are turbine blade failure, turbine shaft failure, failure of crankshafts due to repairs by welding, shaft failures of engine-driven generators, bolt and pin fractures, etc. Case histories are detailed and liberally illustrated.

Press Brake Catalog

The Cincinnati Shaper Co., Hopple St., Cincinnati 25, Ohio, has recently published a 76-page catalog illustrating its line of press brakes, giving application, standard and special features, specifications and dimensions, as well as special equipment for various requirements.

Cooper-Bessemer LS Engines

A new general bulletin, No. L-71, just released by The Cooper-Bessemer Corp., Mt. Vernon, Ohio, provides complete data and specifications of the company's 4-cycle Type LS engines of 15½-in bore and 22-in stroke. Cutaway views, rating curves, space plans, and typical installations are included. Engines are operated by gas, gas-diesel, and diesel, atmospheric or supercharged, and are rated from 690 to 2500 hp.

Industrial Controls

An 80-page catalog, describing and illustrating non-indicating electric, electronic and pneumatic controllers for temperature, pressure and humidity as well as pneumatic and electric valves, switches and relays, has been issued by the Industrial Div. of Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. Specifications, dimension drawings, application data and ordering information are included.

BEYOND COMPARE
THE FINEST GENERATING AND STARTING EQUIPMENT MADE!
Leece-Neville
L-N GENERATORS
are proving their superiority over conventional standard equipment on thousands of jobs. For 6 and 12 volt systems. High output, long life, reliable performance.
L-N CRANKING MOTORS
High torque, fast cranking speed guarantee quick starts even with cold, stiff engine. For 12 volt and 12-24 volt series-parallel systems. Also higher voltages.
L-N ALTERNATORS
For short runs, long idling, heavy current needs, nothing equals the L-N AC-DC Alternator System. 25 to 35 amps idling! To 80 amps for 6 volt systems; to 175 amps for 12 volt. Also higher voltages.
★ Now producing cranking motors, generating systems, pump motors and special equipment for military engines.
For all the facts, write THE LEECE-NEVILLE COMPANY, Cleveland 14, Ohio
Distributors in principal cities... Service Stations everywhere
YOU CAN RELY ON Leece-Neville
HEAVY-DUTY ELECTRIC EQUIPMENT FOR OVER 43 YEARS
TRUCK
BUS
DIESEL
OFF-HIGHWAY
PASSENGER
RAILROAD
MARINE
INDUSTRIAL

Cut nut-running time 75%

*Snap-on Electric IMPACT WRENCH

The fastest wrench you can put in the hands of a maintenance or production worker. Swiftly runs nuts or screws on or off—cuts costs—makes tough jobs easy. The Snap-on impact wrench delivers up to 2,000 powerful rotary blows a minute without twist or hammer shock to operator. Sets nuts solidly, or quickly reverses to break tough ones loose. ½" square drive takes sockets ⅜" to 1 1/16"—many accessory tools available. 2 models—115 volts, 220/230 volts. Available through Snap-on factory branch warehouses in principal industrial centers. Write for Snap-on Industrial catalog and new catalog of 4,000 hand and bench tools for production and service.

SNAP-ON TOOLS CORPORATION
8064-E 28th Ave., Kenosha, Wis.

*Snap-on is the trademark of Snap-on Tools Corporation.

What Do You Know!

(Answers to questions on Page 55)

1. Correct answer is "b". While it is general practice to use special fluids, fuel oil can and is being used. An advantage is that the large oil reservoir helps dissipate the heat. See Page 49 for an application.

2. "c" is generally accepted as an average figure, but of course it will vary with the design and condition of the engine. For discussion, see the article on Page 53.

3. "b" is correct since on each grinding the valve drops further into the head. "a" can be corrected with narrowing stones. "c" is not a factor; materials are selected to withstand the heat. See article above.

4. First sentence is true; second is false. Duration of the rapid impacts (900 per min) is too short to overcome inertia of the tool. For examples of use and savings, see Page 36.

5. Correct answer is "b". Spectrograph identifies and measures amounts of metallic elements (wear metal) in the oil. For details, see Page 42.

6. Correct answer is "a". In addition to identification, by controlling conditions it is possible to measure the amounts of the elements present in the test sample. See article mentioned above for further details.

7. "c" is correct answer. While "a" is partially true in that tests are made in laboratories, the purpose of spectrographic analysis is to predict trouble and thus aid maintenance. See article above.

8. Correct answer is "b". The article on Page 32 describes systems evolved for fully-automatic operation under sub-zero conditions.

9. Both "b" and "c" are correct. The latter is particularly pertinent as cold viscous fuel congealed in the injection system makes starting difficult. See article on Page 28.

Bulletin on DC Generators

A new bulletin describing its complete line of DC generators up to 300 kw has been issued by Columbia Electric Mfg. Co., 4519 Hamilton Ave., Cleveland 14, Ohio. Illustrations of available frame sizes and special design features are given along with details of construction for field frames, field coils, armatures, commutators, brushholders and other component parts.

Designed to be driven by diesel or other prime movers, the generators are built to conform to NEMA and ASA C50 standards and can be supplied as either single or two bearing units for coupled or belt drive with special features or modifications to suit the particular application.

Standardized Construction

The advantages of standardized construction are detailed and illustrated in a new 20-page brochure entitled "Standardized Buildings by Luria", issued by Luria Engineering Co., 500 Fifth Ave., New York 36, N. Y.

The brochure stresses lower overall cost, permanence, speedy erection and flexibility of the steel-frame buildings, which according to the company provide more usuable space, can be adapted to meet special requirements and are designed to meet exacting building codes. Examples are given of economical permanent structures for power plants, pumping stations, etc.

Protective Sleeves

A & A Mfg. Co., 2017 W. Clybourn, Milwaukee 3, Wis., has issued Bulletin BA-1, illustrating various applications for the use of Gortite sleeves. Dripping oil is said to have no ill effect on this Fairprene material.

The sleeves are used in protecting against wear caused by dust, contaminated oil, water, chips, and the hazards of heat and cold. The manufacturer is producing sleeves for vertical uses to lengths of 30 ft. All sleeves are fabricated round, square, rectangular or triangular to user's specifications. No mold is claimed to be required in this process, and ways are being found to meet an expanding range of conditions in the diesel field without assessing mold charges.

MAINTENANCE REPORT

Why Are Replacement Valve Seats .008 or .010 Oversize?

(WHEN FACTORY REQUIREMENTS ARE ONLY .004)

Because Portable Cutting Tools Aren't Accurate!

When the cutter is fed down, the foot will lift slightly even on the best equipment. If the bolt through the Holdown Foot is close to the fulcrum, a *fairly* accurate hole is made. The hole becomes larger *and tapered* when the bolt is moved farther from the fulcrum.

In use, the bolt position may change two or three times on the same cylinder head or block, and holes may vary from .001 to .006. This means that press fit interference varies from .002 to .010. The result is excessive press fit, which causes valve port cracks and distorted, cocked seats, which causes valve burning and breakage.

PETERSON'S

SCREW-IN VALVE SEAT

Eliminates the problem of counterbore accuracy!

Even the heavy-duty P-B Holdown Foot allows oversize cuts, but it doesn't matter BECAUSE THE COUNTERBORE IS THREADED. P-B seats exert no radial pressure—even under extreme heat—due to clearance in threads. They eliminate cracks in valve ports common to some engines. P-B seats will stay round, where pressed seat (especially with excessive interference) distorts quickly. This causes valve failure. P-B gives 2 or 3 times longer valve life, since it cools the valve evenly around the head, where 75% of the heat should be dissipated. Distorted pressed-seat doesn't cool valve. The valve stem grows and sticks in guide. Cocked pressed-seat definitely causes most broken valves.

NORMALIZED **HEAT-TREATED**

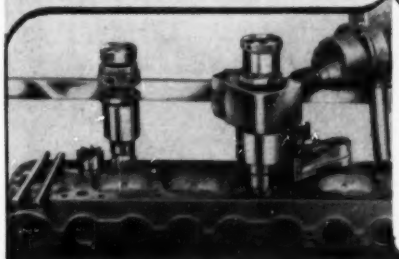
Made of tough chrome-nickel-iron, individually cast under pressure. Unlike pressed-in seats, P-B Screw-In Valve Seats retain their original dimensions, won't buckle and come loose, can't tilt and cause hot spots and valve burning, and allow for perfect seating of valve on every stroke.

Under heat, it expands outward and slightly downward, becoming tighter.

Mechanics say pressed-in seats look like this before they start grinding.

AMAZING PERFORMANCE

- **SAVES COSTLY BREAKDOWNS**—Eliminates 75% of valve burning, sticking, and breakage. Also eliminates 75% of valve port cracks due to radial pressure of expanding pressed-in seats—or valve port cracks in many heads where no seats are used.
- **REPLACE MANY TIMES**—You can replace P-B seats without damaging the threads in counterbore or going to an oversize.
- **NEW-ENGINE VALVE MILEAGE**—And the seat remains tight in the counterbore.
- **EASY TO REGRIND**—After long service just a light touch with the grinding stone cleans it up because it is not out of round.



PRECISION INSTALLATION EQUIPMENT

Patented tooling guarantees threads square with bottom of counterbore, thus insuring self-locking feature.

Special CUTTER makes precision counterbore and tap machines in expansion clearance between thread.

CONTACT YOUR MASTER SHOP TODAY

P-B Master shops are ready to help you solve your valve maintenance problems in every major U. S. city. Call him, or write direct.

PETERSON WELDING LABS. INC.

Pipe Line Filter Folder

A 4-page illustrated bulletin describing four new low pressure pipe line filter models has been announced by the Dollinger Corp., 11 Centre Park, Rochester 3, N. Y. The bulletin contains specifications and engineering and performance data covering this new filter, designed for pressures up to 40 psi, which is recommended by the company for the removal of dust, dirt, pipe scale, condensed oil, and water vapor from compressed air lines.

Oil Field Machine Lubrication

The Texas Co., 135 E. 42 St., New York 17, N. Y., in its April issue of *Lubrication*, tackles the topic of lubrication of oil field machinery. Design of engines and parts are discussed with lubrication and cleaning requirements given. A separate section on diesel and gas engines is included.

Railroad Cleaner Booklet

A special railroad booklet outlining the uses of the Hypressure Jenny Steam Cleaners has been issued by Railroad Supply and Equipment, Inc., 148 Adams St., Scranton 3, Pa.

Fully portable, the unit can be rolled right to the job and is ready to go to work on any dirty, greasy surface from diesel engines to shop floors within 90 seconds from a cold start. Descriptions of typical operations are given for regular or emergency maintenance.

Bulletins on Lister Diesels

The National Supply Co., Engine Div., Springfield, Ohio, has recently released two bulletins describing the Lister 4-cycle stationary diesel engines. Bulletin No. 5204 describes Models FR1, FR2, and FR3, 1500 to 1800 rpm, 8 bhp to 27 bhp, one to three cylinder units. Bulletin No. 5205 describes Models FR4 and FR6, 1000 to 1800 rpm, 36 to 54 bhp, four and six cylinder units.

The 4-page folders give engine dimensions, weights and technical data. The engines have chrome-hardened cylinder liners, individual fuel-injection pumps for each cylinder, and oversize crankshafts. High and low compression ratios for easy starting and normal running, respectively, are selected by spring-loaded levers.

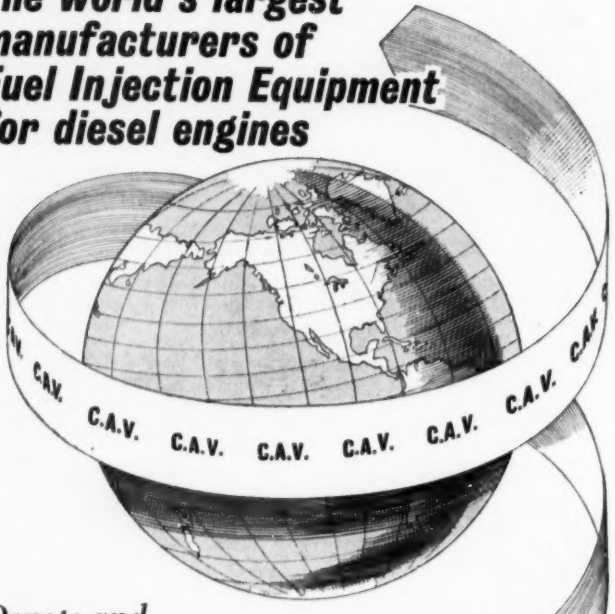
Alco Products Review

The Spring 1953 issue of the *Alco Products Review*, published by the American Locomotive Co., Schenectady 5, N. Y., presents 32 pages of articles of special interest to petroleum refinery and petrochemical engineers.

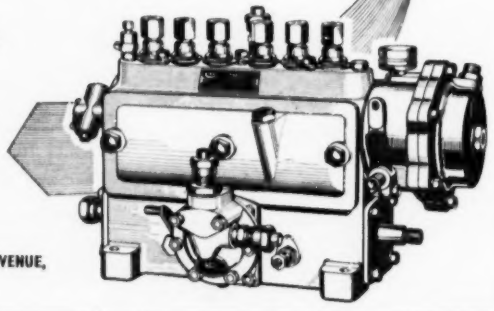
One article describes, in text and drawing, the new presure-tight closure recently developed by the company for pressures from 2000 to 4000 psi. Another article provides the design engineer with a simple set of rules, charts and tables to rapidly determine the comparative effect on cost of the alloys generally used in heat exchangers today. A third article outlines the major differences existing between ASME and API-ASME codes for unfired pressure vessels for petroleum liquids and gases, and makes recommendations as to uniformity of practice in the application of these rules for fabricating, inspection, and testing.

C.A.V.

The world's largest manufacturers of Fuel Injection Equipment for diesel engines



Depots and Service Agents in over 100 countries



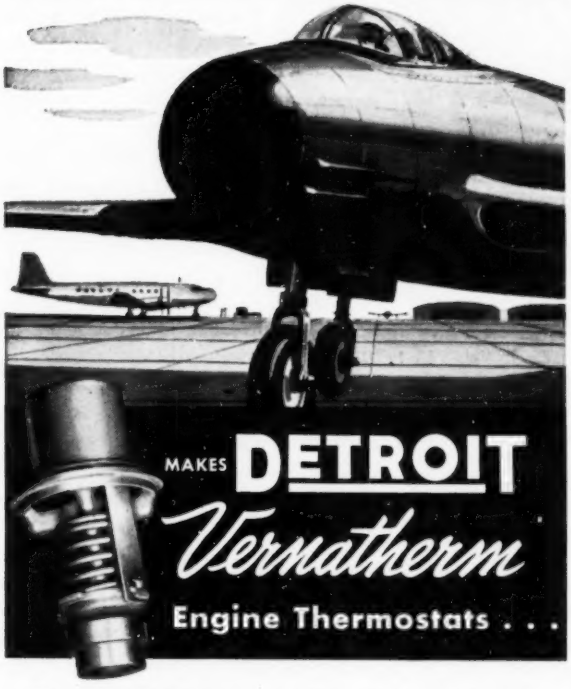
C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC.,
653, TENTH AVENUE,
NEW YORK 19, N.Y.
Sales Office: 14820 DETROIT AVENUE, CLEVELAND 7, OHIO.

C.A.V. **Fuel Injection and Electrical Equipment**

174-606

Dependability...

proven in military and commercial aircraft operation



The *BEST* Choice For Your Needs

If you're concerned with the design of lubricating oil or cooling systems for jet, heavy-duty gasoline or diesel engines it will pay you to specify DETROIT Vernatherm Engine Thermostats. For only DETROIT Engine Thermostats give you the assurance of dependable, efficient operation performance proven on military and commercial aircraft . . . on ordnance combat vehicles . . . and on most diesel makes and models. So take advantage of this outstanding record—specify DETROIT Vernatherm Engine Thermostats, the true standard of the industry for rugged, exacting service! Available as engine cooling thermostats, oil cooler thermostats, shutter thermostats and thermostatic power elements.

All DETROIT Vernatherm Engine Thermostats are . . .

- *Designed to work with either open or closed cooling systems*
- *Built with tight seats for minimum leakage*
- *Not affected by barometric pressure*
- *Not subject to chatter*

ESTABLISHED IN 1877 AS
DETROIT LUBRICATOR COMPANY

DETROIT Controls CORP.

DETROIT 8, MICHIGAN Division of American Radiator & Standard Sanitary Corporation
Canadian Representatives in Montreal, Toronto, Winnipeg—Railway & Engineering Specialties, Ltd.

AUTOMATIC CONTROLS for REFRIGERATION
AIR CONDITIONING • DOMESTIC HEATING • AVIATION
TRANSPORTATION • HOME APPLIANCES • INDUSTRIAL USES
Serving home and industry AMERICAN-STANDARD • AMERICAN BLOWER
CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

FRAM FILTERS *pay for themselves in SIX MONTHS!**

***at Barton Mines Corp., North Creek, N. Y.**

The Barton Mines Corporation works with crystal garnet ore, producing abrasive grains and powders. Three diesel engines in the company's power plant ran in "an exceedingly dusty location," to put it mildly. To combat this condition, Fram lube oil filters were installed. Barton reports these results:

- **Filters paid for themselves in less than 6 months**
- **Liner, ring and bearing wear reduced**
- **Oil after maximum use is as clean as when new**
- **Hard carbon formation on rings and heads minimized**
- **Time between overhauls greatly increased**
- **Lube oil consumption cut in half**

Four Fram Filters manifolded in typical installation where larger filtration capacities are needed.

Fram heavy-duty lube oil filters for all types of diesel engines.

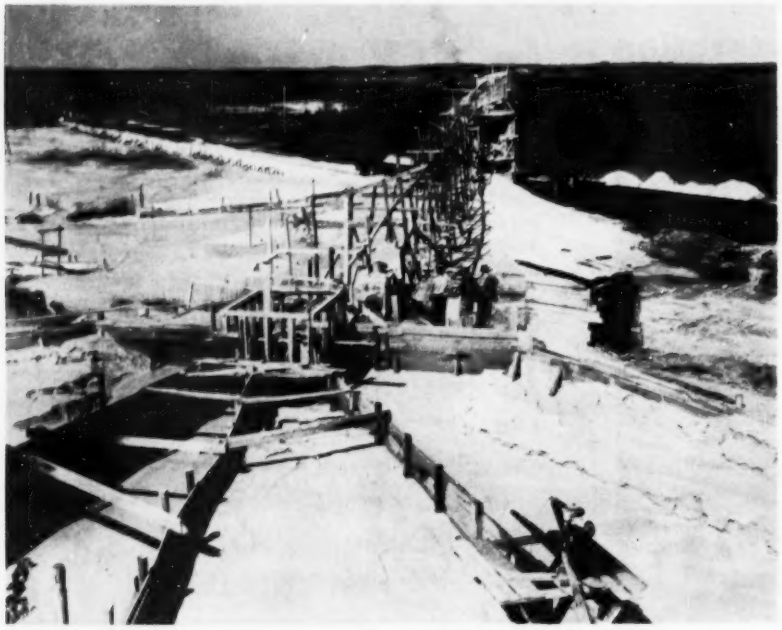
Let FRAM Solve YOUR Diesel Filtering Problems

Fram Filters can protect your diesels, reduce costly down-time, prolong engine life and lower operating costs. Write today to:

FRAM CORPORATION, Providence 16, R. I. *In Canada:* Fram Canada Ltd., Stratford, Ontario.

FRAM
OIL • AIR • FUEL • WATER
FILTERS

Field Notes



Diesel-Powered Pumps Remove Sand Hydraulically

An extensive strip of sand near Junction City, Georgia has kept the Taylor Sand Company working at top speed for the last eight years. The company removes the sand hydraulically, utilizing a series of diesel-powered pumps.

The pumps are used to provide water which is thrown against the walls of the pit and also to circulate the water and dislodged sand towards the loading dock. Ultimately, the water finds its way back to the lake from which it was pumped, but in the course of its return journey the sand is mined, washed, graded, and loaded into railroad cars at the rate of 200 tons per hour. Only 10 men are required for the entire operation.

Water is first pumped from the lake by a Gardner-Denver pump and forced a distance of one-quarter mile to the pit. Here a miniature Niagara is created as water is applied at high pressure. A 6-in pump sucks up the sand and water and delivers it to the separators, 900 feet away. At this point, the sand drops into bins and is hosed to a point where another pump forces it up to a final washer from which it is dropped into railroad cars.

Engineers Inspect Corrosion

The International Nickel Co. is sponsoring a meeting of the "Engineers Group" at the corrosion testing stations at Harbor Island and Kure Beach in North Carolina, June 3-5.

Included on the agenda is a showing of the film, "Corrosion in Action"; a review of the fundamentals of galvanic and stray current corrosion, and cathodic protection; effects of corrosion on small craft; and the effects of velocity on corrosion.

Newspaper Builds Mobile Plant

The Times of London has constructed a completely mobile newspaper plant that in an emergency could produce 12,000 eight-page tabloid papers an hour. It was exhibited for the first time at the British Industries Fair which opened in London recently.

The unit, first planned two years ago, contains everything for the production of a newspaper even to desks for the editors. It comprises two large trailer trucks containing a complete printing plant; a heavy truck carrying a workshop and supplies and towing a trailer with diesel-electric generators; and four small trucks for the staff, each fitted with radio transmitter and receiver. Two high-powered radio stations, one in London and one in the country, have been built to provide communication between the office and the mobile unit.

Erie To Buy 38-Mile RR

The Interstate Commerce Commission has approved a plan to reorganize the 38-mi long New Jersey and New York Railroad Co., which will give entire ownership of the reorganized company to the Erie Railroad Co.

Under the set-up Erie will be required to pay $604,978 in cash as the estimated scrap value of the New Jersey line and about $459,000 to take care of unpaid taxes and interest due the state of New Jersey in the period of reorganization. Erie, which will acquire all the property of the New Jersey, now owns more than 80 per cent of the capital stock of the debtor railroad, which stock has been declared without value by the I.C.C.

Westinghouse Initiates Diesel Locomotive Service Plan

Westinghouse Electric Corp., in cooperation with diesel-electric locomotive builders using its electric equipment, has initiated a new plan for handling electrical renewal parts and unit exchange equipment.

Under the plan Westinghouse is responsible for dealing directly with the railroads on all inquiries, negotiations, and orders involving the following: main propulsion and auxiliary electrical generating equipment; electrical control apparatus; traction motors; pinions, gears and gear cases; and V-belts for main generators. All other equipment remains the responsibility of the locomotive builder.

Westinghouse maintains stocks of electrical renewal parts in warehouses

throughout the country. Under the unit exchange arrangement, electrical rotating units are stocked at 16 locations. When a customer needs a replacement unit, it is shipped to him from stock. The replaced unit is returned to Westinghouse for reconditioning and is placed in the unit exchange pool.

New English Diesel Aero-Engine

D. Napier and Son, Ltd., London, England, has just released further details on the "Nomad", compounded engine for airplanes, designed to provide lowest practicable fuel consumption under any operating conditions. This was accomplished by compounding the simplest form of two-stroke diesel engines with a gas turbine and transmitting the power through a propeller.

The engine also enables a wide range of fuels to be used, such as diesel fuel, kerosene, and wide-cut gasoline. The low fuel consumption is achieved by use of higher compression and expansion ratios than are used in the pure gas turbine cycle.

The "Nomad" consists of a simple two-stroke diesel to which is added a turbine compressor set. The axial-flow compressor is on one shaft with a multi-stage exhaust turbine. The turbine compressor so formed is coupled by gearing to the compression-ignition engine. Power from the engine and extra power from the exhaust gas turbine are transmitted to a single rotation propeller shaft by a reduction gear in the nose of the engine assembly. Control is by a single pilot's lever. The engine weighs 3580 lb, and has a take-off power at sea level of 3135 hp.

Test Silvium in Batteries

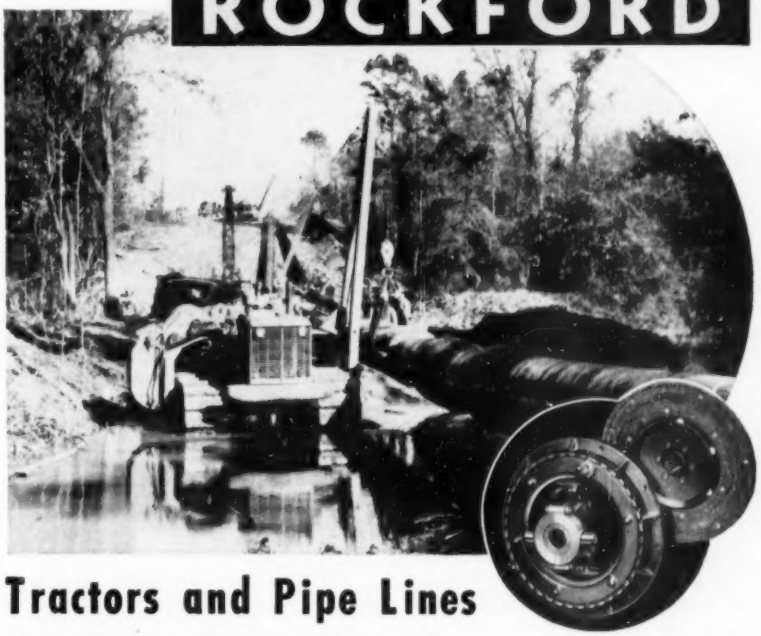
In an effort to improve its product, the Electric Storage Battery Co. has been following a program of field-testing batteries. It found that identical batteries made under identical conditions with identical materials varied widely in performance and life.

Research engineers digging into the problem concluded that something in the alloy of the positive plate was causing this wide variation. They discovered that pure silver added in controlled quantities to the lead of the positive plate held great promise of improving the product. A particular lead-silver alloy containing controlled quantities of other metals was determined to be satisfactory. After extensive tests, this lead-silver "plus" alloy (given the name of Silvium) was put into production.

In August of 1951, the first production automotive storage battery containing Silvium cells, the Exide Ultra Start, was put on the market. Executives of the company, when questioned about the potential life of these batteries stated: "We have no idea".

However, a documented case has been brought to the company's attention. An Exide Ultra Start battery was installed in a new prowl car of the South Portland Police Department in August 1951 and scheduled for replacement at about 35,000 miles. From previous experience, the police estimated that constant current drain caused by such heavy duty accessories as the siren and 2-way radio would wear the battery out at that point. After 65,000 miles, the prowl car was

CLUTCHES by ROCKFORD



Tractors and Pipe Lines Go Right Thru Obstacles

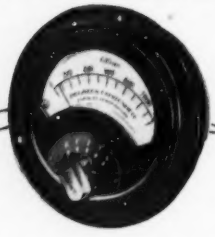
ALLIS-CHALMERS tractors are rugged enough to absorb the punishment met in transcontinental pipe-line construction. Heavy-duty ROCKFORD CLUTCHES help them move maximum size loads thru tough going — with ample margin of safety. Let ROCKFORD clutch engineers help you design dependable, flexible controls for your machine's powerline.

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD CLUTCH DIVISION BORG-WARNER
1301 Eighteenth Avenue, Rockford, Illinois, U. S. A.

award winner has ALNOR PROTECTION



Efficient operation of 1400 horsepower won for the Johnson plant, 1952's REA award. Care and attention to detail enabled them to produce more than 28 million KWH at 9.55 mills per KWH.

Alnor Exhaust Pyrometers gave a constant check on efficiency of all six engines in the plant—gave advanced warning of . . .

Cylinder Overload Preignition
Scaled Jackets Clogged Parts
Detonation Faulty Injection

Get the best in efficiency from your diesel—minimum fuel consumption per horsepower and long service uninterrupted by foreseeable breakdowns. Get constant protection of your engine, cylinder by cylinder, with an Alnor Exhaust Pyrometer System.

Get Full Information—*Quickly!* Your nearby Alnor Diesel specialist is conveniently listed in the classified directory. Ask him to help you select the Pyrometer and thermocouple assembly designed for your engine. Or send for Bulletin 4361 with complete details of the full Alnor line of Pyrometers.

ILLINOIS TESTING LABORATORIES, INC.
Room 507, 420 N. La Salle St., Chicago 10, Illinois

traded in, but the battery was retained and installed in a second car. After this second car was withdrawn from service, the same battery was transferred to still a third car where it is in active use as of today after over 150,000 miles of service—and it still has never been recharged.

ICEI Elects New President

R. C. Wietersen, director of purchases of the Buda Co. of Harvey, Ill., has been elected president of the Internal Combustion Engine Institute, whose membership includes the major manufacturers of diesel and gasoline engines.

Other officers elected were: vice president, J. E. Heuser, sales manager—engine division, Le Roi Co. of Milwaukee; secretary, R. H. Kerr, chief engineer, Climax Engine and Pump Mfg. Co. of Clinton, Iowa; and treasurer, J. D. Cook, secretary and treasurer, Hercules Motor Corp. of Canton, Ohio.

Lowly Bugs Can Stall a Train GE Finds Device to Foil Them

Railroaders have for some time been berating the tiny caterpillar, bug and worm for stalling trains. These pesky little creatures, whose remains leave slick spots on the rails in the path of oncoming locomotive wheels, have caused many a slippage especially on steep grades when the train is extremely heavy or when the locomotive is working near to maximum adhesion on the rails. This slippage, can, and many times does, stall the train.

Even if it doesn't stall the train, the slippage will cut down the pulling power of the locomotive. It may also overheat the traction motor or damage it by excessive speed. Wheel slippage

Which of these jobs would you like to do

FASTER, EASIER?

- **Cleaning filters**
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can also be caused by atmospheric conditions, wet spots or ice patches on rail, or they say, by a banana peel.

For two years General Electric has been testing an electric device designed to correct slippage and is now ready to put it on the market. The equipment, they claim, is much simpler than previous devices and less costly to maintain. The device, including a switch unit mounted at one end of each axle, goes into action when any axle starts spinning faster than the others. To correct this, the device removes the power to all wheels until balance is restored. Power is then automatically restored, slowly enough so that all wheels run at the same speed, and the locomotive again achieves full power. No attention from the engineer is required.

NYC Orders 164 More Diesels

The New York Central System announces it has placed orders for 164 more diesel-electric locomotive units, costing about $27,500,000. When deliveries are completed by this fall, all service east of Cleveland and passenger service east of Detroit, will be fully dieselized. This will mean elimination of the last steam locomotives in Central's 2800 miles of roadway within New York State.

It was on the 16-mi line between Albany and Schenectady that a predecessor railroad, the Mohawk and Hudson, inaugurated steam-powered travel in 1831 with a historic, wood-burning locomotive called the DeWitt Clinton, an 11½-ft forerunner of the steam locomotive.

With the new equipment, the Central will have 2113 diesel units with a total horsepower of 2,758,900, which the road estimates will amount to approximately 60 per cent necessary for complete dieselization of the system. The locomotives are to be built by the Electro-Motive Div. of General Motors at LaGrange, Ill., and the American Locomotive Co. at Schenectady, N. Y. Thirty-four units will be 2250-hp passenger engines; 80 are to be 1500- and 1600-hp road switchers for passenger, freight and switching service; 15 will be 1500- and 1600-hp units for freight and switching; and 35 will be 1000-hp yard switchers.

Pickering Changes Hands

Victor W. Farris, president of Farris Engineering Corp., of Palisades Park N. J., announces the acquisition of the Pickering Governor Co. including all patents, inventory and equipment. Production of the governor will be carried on in the newly enlarged Farris plant.

With this change, the firm becomes a Farris affiliate and will be known as the Farris Pickering Governor Co. Under the new management expansion of the line is planned along with improved servicing and availability of replacement parts.

Buda Ups Fork Lift Production

The Buda Co. announces it has just completed new plant facilities to increase production of its line of fork lift trucks. According to Mr. Ralph K. Mangan, president, the new facilities will step up deliveries to double the previous rate. The present line was introduced by the company less than two years ago.

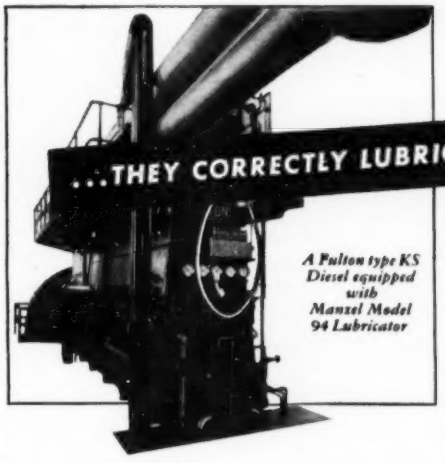
Joy Buys Barnes and Reinecke

Barnes and Reinecke, Inc., engineering company specializing in mechanical research and development, was recently acquired by Joy Mfg. Co., Pittsburgh manufacturer of mining equipment and industrial products. The company will continue to operate under its present name as a subsidiary of Joy.

The recently acquired company is a 19-year-old enterprise most of whose services have been in engineering development, particularly in the automotive field.

Among the firm's achievements have been the invention of certain patented features of a lightweight, air-cooled, multi-fuel diesel cycle engine whose principles can be adapted to any prime movers including airplanes. Its engineers have also done work on "servomechanisms" for automatic operations and have made contributions to the development of a lightweight high pressure compressor for the government.

LEADING DIESEL ENGINES HAVE *Manzel* FORCE FEED LUBRICATORS



...THEY CORRECTLY LUBRICATE EACH POINT

A Fulton type KS Diesel equipped with Manzel Model 94 Lubricator

Manzel Lubricators supply the *exact* amount of oil needed at each wearing point, reducing oil consumption as much as 90%.

They are furnished as standard equipment on leading makes of engines, and machinery. Or they can be installed on your present equipment.

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Why it Pays to Select Manzel Lubricators

- THEY LENGTHEN THE LIFE OF MACHINERY
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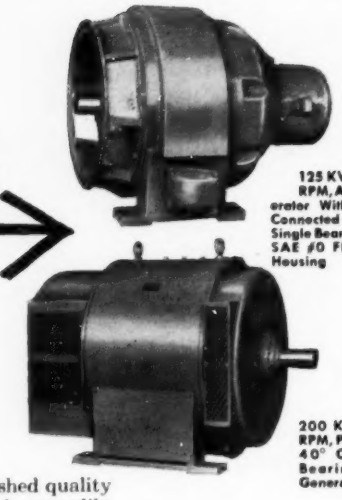
- THEY ELIMINATE "DOWN TIME"
- THEY CUT OIL CONSUMPTION UP TO 90%

Manzel 271 BABCOCK STREET BUFFALO, NEW YORK

Powerful Companions for Your Engines



125 KVA, 1200 RPM, A.C. Generator With Direct Connected Exciter, Single Bearing With SAE #0 Flywheel Housing

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● For over 25 years Columbia has furnished quality built generators for engine drive. They're sturdily built with materials of the highest quality to provide dependable power.

Your needs can be supplied promptly, whether your requirements are for single bearing generators with or without adaptor for SAE flywheel housing, or for units with two bracket bearing design. A.C. ratings 6.25 to 1000 KVA, D.C. ratings 2 to 300 KW. Our engineers will be glad to review your requirements.

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Quality Precision Crankshafts For Diesels — Since 1910 . . .

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CRANKSHAFTS · CONNECTING RODS
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ARBA Moves Headquarters

The American Road Builders' Association announces removal to new headquarters at the World Center Bldg., 918 Sixteenth St., N. W., Washington 6, D. C.

Speed-Up in Canadian Railway Dieselization Is Foreseen

Complete dieselization of Canadian railways may be in effect before 1968, according to Mr. William G. Miller, executive vice president of the Montreal Locomotives Works, Ltd. In an address before the Canadian Railway Club recently, he said his estimate was based on the assumption that United States dieselization would be completed in 1963.

Mr. Miller said that at the present time 50 per cent of the locomotives in the United States were diesels compared with 15 per cent in Canada. He indicated that the program of dieselization in Canada was similar to the United States, with a lag of five years.

Of the present 4300 steam locomotives operating in Canada only 372, or 9 per cent, were less than ten years old, he observed. Nearly half the steam locomotives were 30 years old or older and there were still a dozen in service which were 50 years old.

"The effect of lower diesel operating costs on the retiring age of steam locomotives will become more pronounced as steam expenses rise with their declining numbers", he continued. In actual practice, locomotives were replaced on an average of after 42 years of operation. "When considering only in the light of their past average retiring age, one feature becomes clear; the large amount of buying of motive power carried on by the railways between 1910 and 1920 and the restricted buying since, must have its repercussions in a surge of increased buying no later than the period 1956-65."

OGP Meets at Milwaukee

The 25th Oil and Gas Power Conference and Exhibit, sponsored by the Oil and Gas Power Div. of the American Society of Mechanical Engineers, is scheduled to take place May 25-28 at the Hotel Schroeder in Milwaukee.

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Nos. 53 and 55

Rotary Geared Pumps

with Helical Gears and Antifriction Bearings

Long life is an important characteristic of these Brown & Sharpe Rotary Geared Pumps. Extremely accurate helical gears and precision antifriction bearings assure smooth, efficient operation at high speeds and under pressures up to 200 psi. Specially designed mechanical seal prevents leakage and eliminates gland adjustments.

Two sizes available — No. 53 with 4 to 23.3 gpm. capacity, and No. 55 with 9 to 34.1 gpm. capacity — at 0 lbs. pressure. Write for Pump Catalog listing complete line for diesel applications. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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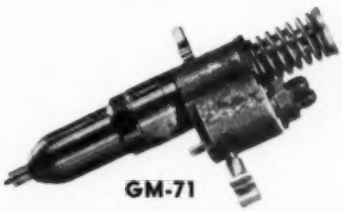

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FACTORY NEW — INTERCHANGEABLE
FIELD TESTED & PROVEN
Imported-Replacement
INJECTOR & FUEL PUMP PARTS
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INTERNATIONAL — BOSCH
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also
INJECTOR EXCHANGE SERVICE
with
NO REWORKED PARTS
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PIERCE
CENTRIFUGAL governors give you exact R.P.M. control . . . at LOWER COST

For more than 40 years Pierce has specialized in the speed control field. Pierce *Centrifugal* Governors, engineered specifically for your Diesels, give accurate, dependable control of engine RPM to meet the varying conditions of any job. Pierce Governors are standard equipment on many of America's finest diesel engines . . . assuring maximum protection, dependable performance—at lower initial and maintenance cost. Replacement governors and parts are available through your local distributor or fuel injection service station.

For distributor's name or information on special governing problems, write

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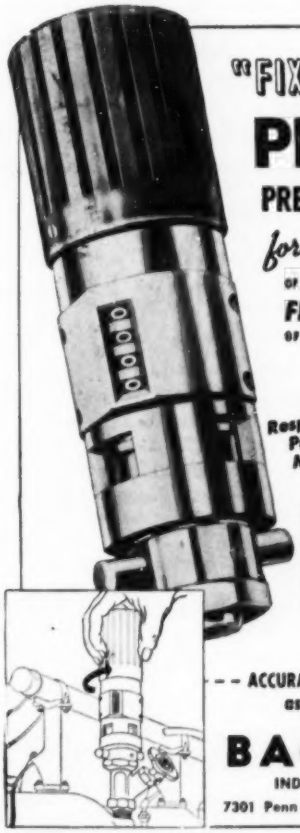
"WORLD'S MOST EXPERIENCED GOVERNOR MANUFACTURER"



"FIXED-READING" PREMAX
PRESSURE INDICATOR

for DIRECT-READING OF COMPRESSION AND FIRING PRESSURES
OF EVERY TYPE OF DIESEL ENGINE

ONE OF THE FEATURES Responsible for Its Overwhelming Preference by Leading Diesel Manufacturers and Operators

No mistake can be made in reading—since only one figure appears in the window of the counter—and this figure represents the actual engine pressure directly in pounds per square inch.

For other features, write for Bulletin 294

ACCURATE PRESSURE READINGS as high as 1700 P.S.I.

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Organizational News

Cleveland Diesel Changes

Several organizational changes have recently occurred at the Cleveland Diesel Engine Div. of General Motors Corp.

H. W. Barth, most recently chief mechanical engineer at the Electro-Motive Div., becomes chief engineer at Cleveland. For the first time in several years, this appointment will consolidate under one head all the product engineering activities in the division. Barth joined a predecessor of Cleveland Diesel, the Winton Engine and Mfg. Co., in 1934. In 1936 he was transferred to Central Diesel, at research, where he worked on development of the GM locomotive engine. In 1938 he went to Electro-Motive.

In line with this revamping of the engineering department, Harry Heinzen, who has been chief electrical engineer, becomes assistant chief engineer—electrical. Eric Brater, technical assistant in the mechanical engineering department, will be assistant chief engineer — mechanical. W. E. Brill will continue as assistant chief engineer — design and development. Horace Trainer, who has been engineering field representative, is now on the electrical engineering staff.

D. F. Rogers

H. W. Barth

L. P. Struble, Jr.

J. K. Beidler

In appointments affecting other departments, Donald F. Rogers has been named service parts manager, filling a vacancy created by the death of Ray Pollock. His first employment was at Winton as a factory worker in 1933. He was transferred to the traffic department in 1936 and was named traffic manager in 1946, a post he held up to this recent appointment. Activities formerly under his direction will function as a part of the production control department under the supervision of Robert F. Betz.

Dravo Elections

Two new vice presidents were elected by the directors of Dravo Corp. at its annual organization meeting. The vice presidents, both directors, are John K. Beidler, general manager of the machinery division; and Louis P. Struble, Jr., general manager of the Keystone division. Also elected were Clifford A. Hill as treasurer and Edward T. Fitch as controller.

Mr. Beidler started with Dravo in 1935 and was elected a director in 1952. Mr. Struble began with the company in 1935 and was elected

"AMOT" THERMOSTAT

"Performance without trouble" is the reason more engine manufacturers, pipe lines, power plants, oil companies and shipyards are using AMOT as standard for automatic engine water and oil temperature control. AMOT thermostats offer the following advantages:

1. Large capacity combined with light weight.
2. Excellent reliability even under extreme shocks and vibration.
3. No external bulbs or tubing to break and cause trouble.
4. Temperature is fixed and cannot be tampered with by operator.
5. Holds close regulation and is not sensitive to pressure.
6. Operating forces are very large and with no packing glands there is no chance of valve ever sticking or becoming inoperative.
7. Because of its simple and rugged construction, practically no maintenance is ever required.
8. Has positive 3-way valve action in which full pump capacity flows through the engine at all times.
9. Compact in size and will operate in any position, which facilitates piping.
10. Available in pipe sizes up to 6" for all types of gas and diesel engines.

Write for catalog and name of your nearest AMOT representative.

AMERICAN MOTORS CO., RICHMOND 5, CALIF.

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Packed with Time-Saving, Money-Saving Kent-Moore Special Service Tools

Now available. Kent-Moore's comprehensive new GM Diesel Service Tool Guide. Describes and illustrates more than 300 special tools, developed expressly to meet the essential maintenance requirements of your GM Diesel engine applications. Tools that will save you money, time, and labor. Send for your copy of this Guide today! It's FREE!

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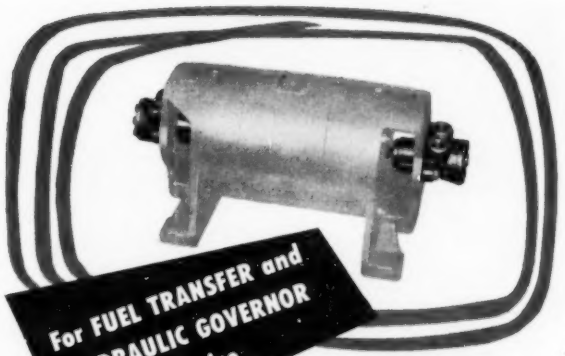

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MODEL L PUMPS ARE PERFORMANCE-PROVED

Throughout the diesel industry, Tuthill Model L pumps are recognized for their dependability in fuel transfer and hydraulic governor service. Model L is a mechanically-sealed, positive displacement internal-gear rotary pump, assuring quiet, leak-free operation with low power consumption. Capacities from .33 to 6 g.p.m. in wide pressure ranges. Available as single or double-pump units. Write for Catalog No. 101 including Pump Guide for diesel applications.

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Dependable Rotary Pumps since 1927
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MODEL K-120 UNIVERSAL PEAK PRESSURE INDICATOR

For Testing Firing and Compression Pressures on all Models of Diesel and Gas Engines. Dependable — Rugged. May be Used With or Without Flexible Tube.

MODEL K-120 Indicator has but one moving part — nothing to wear or get out of adjustment.

VALVE — Gas trap type with diaphragm type check valve having adjustable lift. Stainless steel valve and seat.

No springs — No pistons — no complicated adjustments — No temperature corrections — no pressure loss in check valve.

GAGE READS TRUE PRESSURE — MAY BE RECALIBRATED ON ANY GAGE TESTER

Check readings can be made over and over again by releasing indicated pressures with bleeder valve.

ADAPTORS available for most models of engines manufactured in U. S. A. Other models made to order at reasonable prices.

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

a director in 1951. Mr. Hill joined the company in 1929 and was elected controller in 1944. Mr. Fitch entered the company in 1928 and was named assistant secretary and assistant treasurer in 1942.

New Alco Assignments

Appointment of Charles F. Venrick as manager, Alco-GE locomotive sales and field service, and Ralston A. Weston as manager of stationary and marine diesel engine sales has been announced by the American Locomotive Co.

Mr. Venrick has been employed by the company since 1936, starting as a special apprentice and serving as sales representative, special assistant to the vice president, and assistant district sales manager in the Chicago office. In 1947, he was transferred to San Francisco as district sales manager. He remained there until 1952 when he returned to Schenectady as assistant to the vice president and contracting officer for the ordnance division. He replaces Mr. John P. Delaney who was recently appointed general manager of transportation services.

Mr. Weston joined the company in 1946 as a marine and stationary diesel engine sales engineer at Auburn. Since 1948, he has been assistant manager, renewal parts department at Schenectady. Formerly he had been with the Garlock Packing Co. as a design engineer, following which he became a member of the Army Ordnance Corps.

Charles Venrick

Ralston Weston

James Duff

Allen Greenlaw

Sharples Names Sales Manager

The Sharples Corp. announces the promotion of Allen R. Greenlaw to the post of general sales manager. Mr. Greenlaw, a graduate of the University of Pennsylvania, has been connected with the corporation for a number of years in various sales capacities in New York, Philadelphia and Houston.

Cuno Sales Elevation

James E. Duff, who has been advertising and sales promotion manager for the past year and one-half, has been appointed eastern district sales manager of the Cuno Engineering Corp.

Mr. Duff moved to the company from Frank W. Hankins & Co., where he served as sales and marketing consultant. Prior to that he served as assistant sales manager at Ingersoll-Rand. He has a degree in industrial engineering from Lehigh University.

Engine room of the George T. Horton diesel-powered river tow boat, of the John I. Hay Co., Chicago, which can tow 200 freight cars up stream. Left front, Viking two-way lube oil pump.

Diesel-Powered Tow Boats

Rely Upon VIKING ROTARY PUMPS

Vital lubricating oil is delivered to bearings of two diesel engines with Viking automatic reversing lube oil pumps, whether tow boat moves forward or in reverse. The pumps derive power from crankshafts of engines and operate in both directions. This exacting job requires dependable pumps and Vikings deliver satisfaction.

Your pumping problem may call for the Viking rotary pumping principle—"a gear within a gear" and only two moving parts. For descriptive bulletin 53SD write

Get Our Catalog in 3 MINUTES

Viking PUMP COMPANY
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We are Experts in Re-Manufacturing Injectors!

SAVE WITH INTERSTATE LOW COST DOUBLE-TESTED

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Interstate Diesel Service Features:

1. We ship *immediately* on receipt of your order. *We do not wait for your unit.*
2. Every part carefully inspected. Only genuine replacement parts used when needed.
3. All re-manufacturing work done in modern shop using the latest precision equipment.
4. Every unit thoroughly double-tested and guaranteed to meet the most rigid specifications.
5. FOR SMALL EXTRA CHARGE WE WILL CONVERT ANY INJECTOR FROM ONE SIZE TO ANOTHER.
6. 60-70-80-90 and DF6's available from stock. Exchange size for size.

NOTE: Check our repair service on series No. 110 injectors, fuel transfer pumps and blowers.

SAVE WITH INTERSTATE—SEND TRIAL ORDER NOW!

Attractive Distributor and Dealer Propositions Left in a Few Areas—Write!

INTERSTATE DIESEL SERVICE, INCORPORATED
7120-A CARNEGIE AVE. • CLEVELAND 3, OHIO
"AMERICA'S FINEST DIESEL COMPONENT REBUILDERS"

National Supply Advancements

A series of advancements has been announced within the Springfield Engine Div. of The National Supply Co.

Charles K. Olson, Jr., has been named manager of sales, moving up from the post of assistant general manager, a position he occupied since 1951. Robert M. Pearson, for the past 10 years manager of sales, has been selected as manager — Inland marine sales with headquarters in Pittsburgh. He has been with the company for 17 years. Philip W. Place, formerly staff assistant to the general manager, is now assistant to the manager of sales. J. H. Newton, applications engineer, has been promoted staff assistant to manager of sales.

In another announcement, it was learned that Naurice G. Cummings, a vice president of the company, has been elected to its board of directors. Widely known in the petroleum industry, he joined the company in 1940 as vice president in charge of its Texas division. From 1933 until he joined the company, he had had his own pipe business in Houston.

Borg-Warner Addition

Appointment of R. B. Crean as administrative assistant to the president of Ingersoll Products Div., Borg-Warner Corp., was recently announced. Mr. Crean resigned as vice president, Eddystone Div., Baldwin-Lima-Hamilton Corp., to assume the position. He had previously been comptroller of the National Electrical Manufacturers Assn.

Engineer Joins Trane

The Trane Co. announces the addition of Wyman K. Ender to its products engineering department. He will work on development of the company's hermetic centrifugal refrigeration units.

Naurice Cummings

William Wilson

Snap-Tite Election

Snap-Tite, Inc. announces the election of Armand A. Probeck to vice president of the company. Mr. Probeck is well known in the metals industry having maintained offices in various cities as A. A. Probeck & Co.

Worthington Retirement

William O. Wilson, commercial vice president of Worthington Corp., announces his retirement after 53 years of service with the corporation and its predecessor companies. Since 1944, he has been responsible for general supervision and direction of all of the firm's commercial activities in the Chicago, St. Louis, Kansas City, and St. Paul office territories.

He began his service in 1898 when he joined the Jeanesville Iron Works Co. as a machinist, subsequently becoming an erecting engineer and salesman. In 1919 Mr. Wilson was appointed district manager at Pittsburgh and in 1928 was transferred to Chicago as district manager. From 1937 to 1944 he was sales manager of the Mid-West district.

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SEPARABLE BASE SERIES

These instruments are a series of marine type thermometers designed for all diesels and all plant uses—water-oil-exhaust.

FEATURES All brass construction, nickel finish, cork insulation.

(Repair service available).

33 years continuously in the diesel engine game.

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BEST for DIESELS! How are your Revs?

STICHT UNIVERSAL HAND TACHOMETERS
CENTRIFUGAL TYPE
5 RANGES IN ONE INSTRUMENT
CATLG. 303:
30-12,000 RPM
FOR DETAILS WRITE FOR BULLETIN NO. 750.

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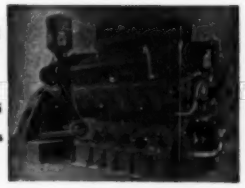

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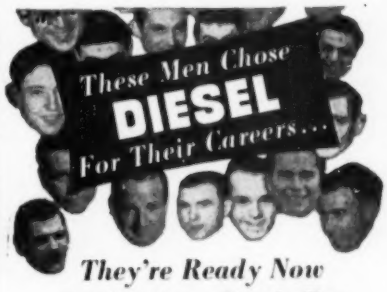

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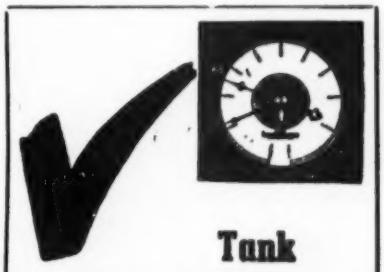

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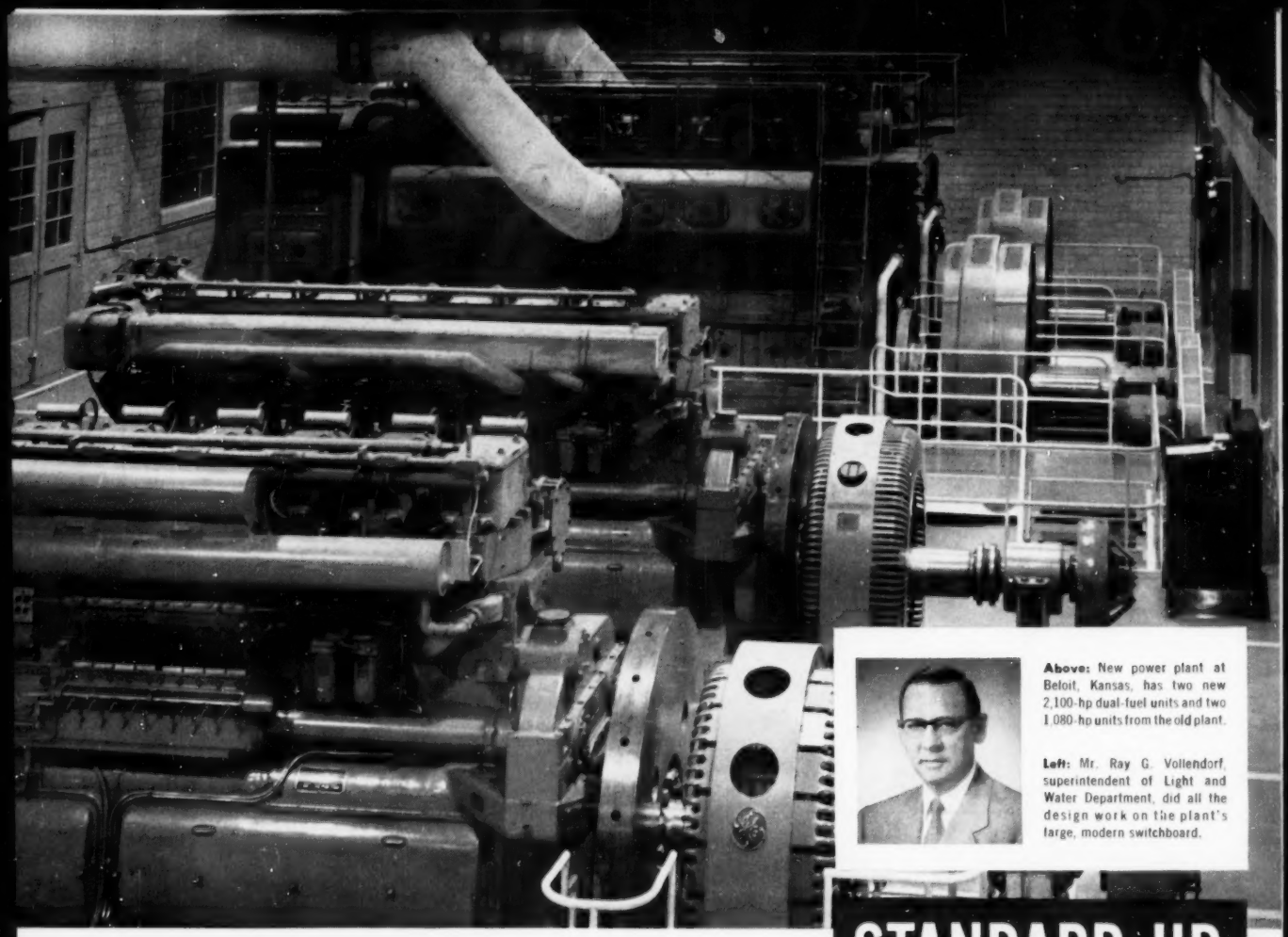

Above: New power plant at Beloit, Kansas, has two new 2,100-hp dual-fuel units and two 1,080-hp units from the old plant.

Left: Mr. Ray G. Vollendorf, superintendent of Light and Water Department, did all the design work on the plant's large, modern switchboard.

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